

17 Pages of New Ideas for Your Vacation

POPULAR SCIENCE

JUNE • 35c Monthly

EXTRA Double-Length True Science Adventure
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used to taste?
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still do**



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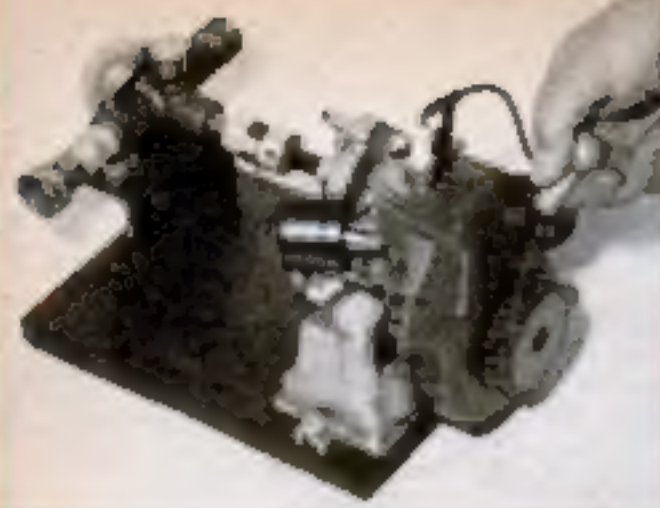
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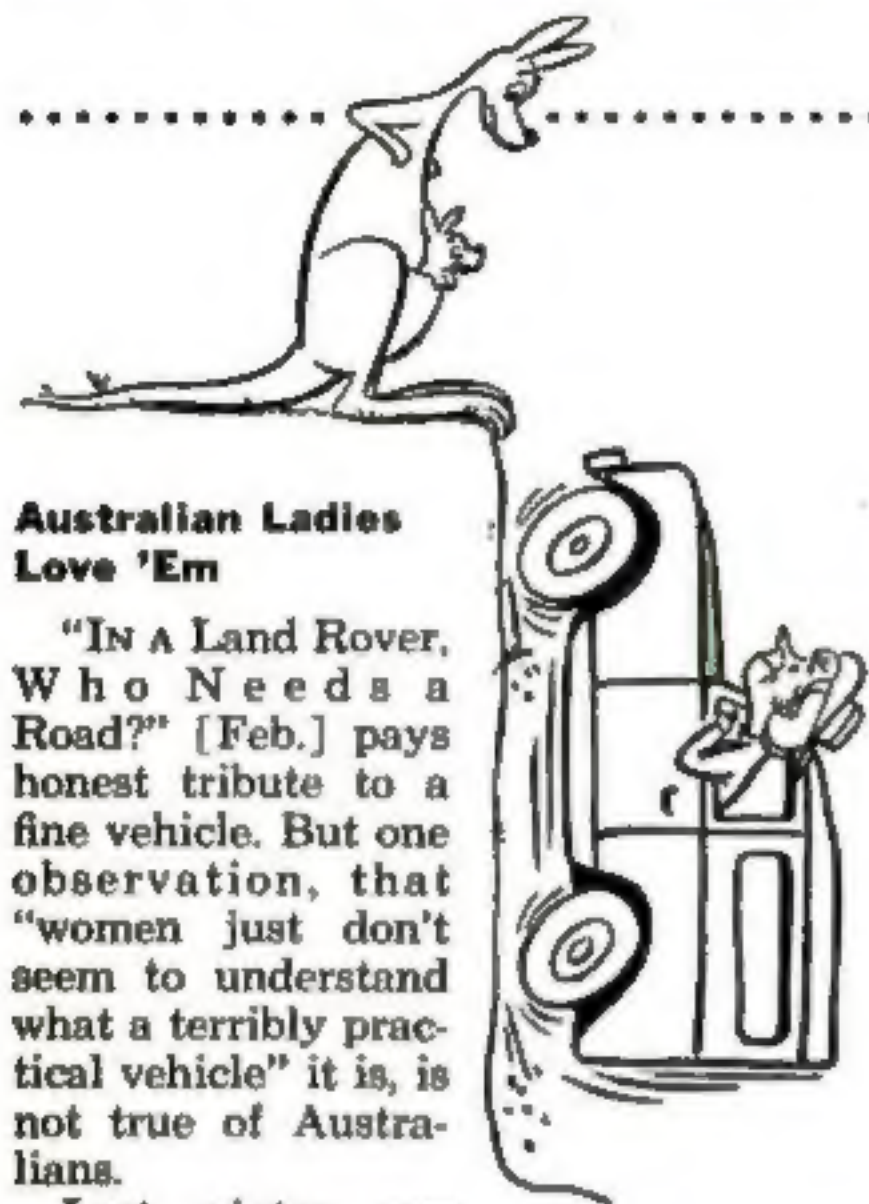
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PS Readers

TALK BACK



Australian Ladies Love 'Em

"IN A Land Rover, Who Needs a Road?" [Feb.] pays honest tribute to a fine vehicle. But one observation, that "women just don't seem to understand what a terribly practical vehicle" it is, is not true of Australians.

Last winter, my husband and I traveled 10,400 miles in a Rover. For 6,000, we pulled a caravan. Roads were various: good bitumen, gravel or washboard, "bull dust" and pot holes as big as bathtubs (through which we staggered at 5 m.p.h.), black soil, and sandy wheel tracks through waist-high grass. Rivers were all dry, but their sandy or rocky beds were 100 yards wide. There was not a bridge for nearly 2,000 miles. Hundreds of small creek crossings had to be negotiated, often at a 40-degree or steeper angle with a sharp V at bottom.

Sometimes we left the caravan behind and went hundreds of miles into semi-desert or open tropical jungle, contending with deep sand, ant hills, knife-edge mulga roots, and "jump ups." These last are sudden changes in land level, usually a sharp, almost vertical rise, 4-12 feet high. Four-wheel drive was essential to climb them.

We had one puncture from a mulga root, but our gallant engine never faltered. No wonder Australian women in mountainous areas appreciate and drive these sturdy machines.

FRANCES I. MORONY, Dundas, N.S.W.

Safety Award for PS

It is my pleasure to inform you that the National Safety Council's Public Interest Award has been granted to POPULAR SCIENCE. We here at the Council know all you have been doing for safety, and we are delighted that the judges agreed.

I am sure you feel, as we do, that there is another dividend as a result of your safety efforts—the knowledge that you have helped prevent many accidents.

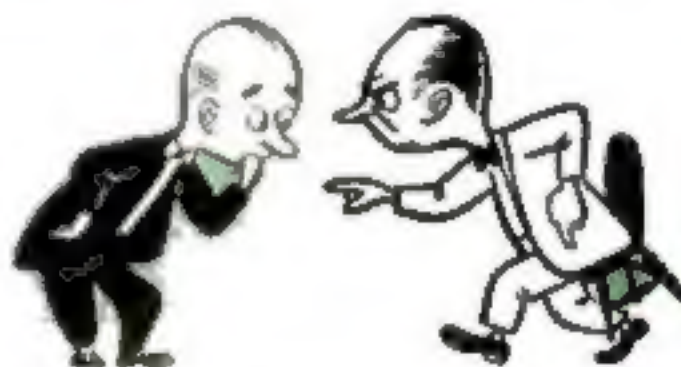
HOWARD PYLE, President
National Safety Council, Chicago.

This makes it 11 years straight that PS has received the NSC award.

Rub, Rub, Rub the Wood

THE article by R. C. Stanley ["An Old-Timer's Formula for Wood Finishing," Mar.] was among your best. I use the formula myself in my wood-finishing business and I know it brings out all the natural beauty of the wood.

After years of experience, I'd say that most complaints of a sticky surface are not due to use of raw, instead of boiled, linseed oil. Usually the sticky surface



can be laid to improper application. Beginners apply too thick a coat, don't squeeze out the rubbing rag as dry as possible, and don't rub till the surface looks dry and feels dry to the hand.

Follow Mr. Stanley's clearly set-out instructions and you should have no trouble.

STEPHEN NOLAN, Waco, Tex.

Advice for Tool Users

HERE's one more jig to add to your helpful collection ["Full Use from a

"THEY TOLD ME I DIDN'T HAVE WHAT IT TAKES!"



The words hurt. But deep down I knew what the boss was saying was true.

"Sure you're a good man, Frank. You work hard. What we need, though, are men with special training. Job specialists who can come up with the right answers. Nowadays experience isn't enough."

So there was the answer. Why other younger men were moving ahead, earning pay raises, getting the good jobs. Why I was being left behind.

I just didn't have what it takes.

You feel desperate at times like that. Family to support. Job to hold down. No chance for the future.

Then I heard about I.C.S. How I.C.S. had helped others like me get the job training they needed to get ahead. Some even found new careers.

I figured maybe I.C.S. could help me. I clipped

out the coupon from an I.C.S. ad and mailed it in. The free career kit I received a few days later convinced me to sign up for a course.

Things began to happen after that. The instruction was practical, down to earth. It seemed what I learned the night before I was able to apply on the job the next morning.

Word got around I was taking an I.C.S. Course. My boss learned of it and three months later I got a raise. Six more months and I got another. Now I'm looking forward to a promotion.

Once in a while I remember the time the boss said I didn't have what it takes. Makes me smile now. But still I thank my lucky stars for I.C.S.

Maybe you will, too.

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- ☐ Sewage Plant Operator
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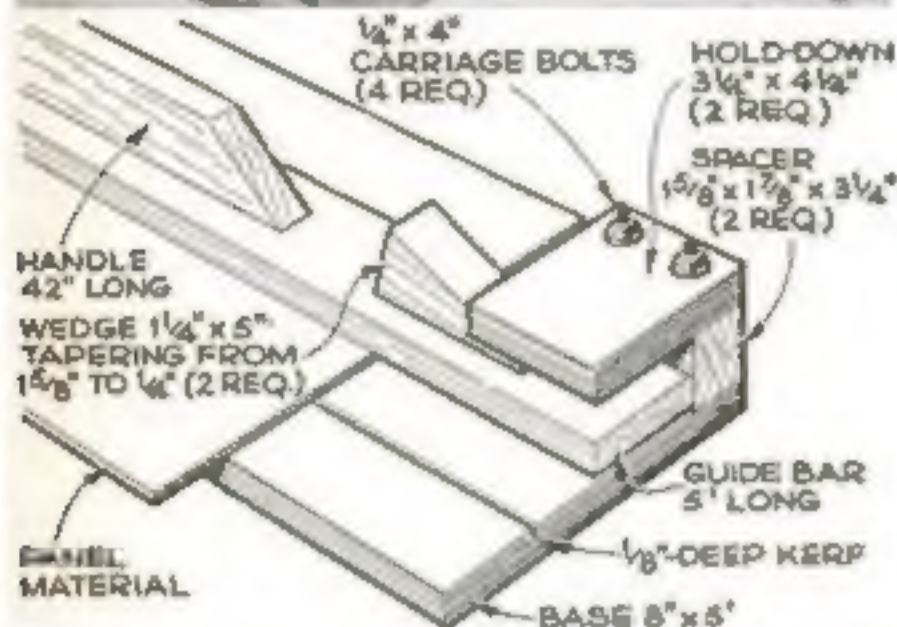
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'Cut-Off' Saw," Jan.]. I designed it for making straight cuts on plywood and



hardboard panels. Tacking a guide strip to the face of such panels means holes to fill later. I position my panel across the base, lining up the layout line with the saw kerf, and wedge the guide bar in place on top. I set the saw to cut about $\frac{1}{8}$ " deeper than the panel thickness. The jig can rest on any surface, without blocking up for blade clearance.

Cut the spacers and wedges from a two-by-four; the base and hold-downs from $\frac{3}{4}$ " plywood; the guide bar and handle from a pine or spruce one-by-three. Attach the handle with $1\frac{1}{2}$ " flat-head screws.

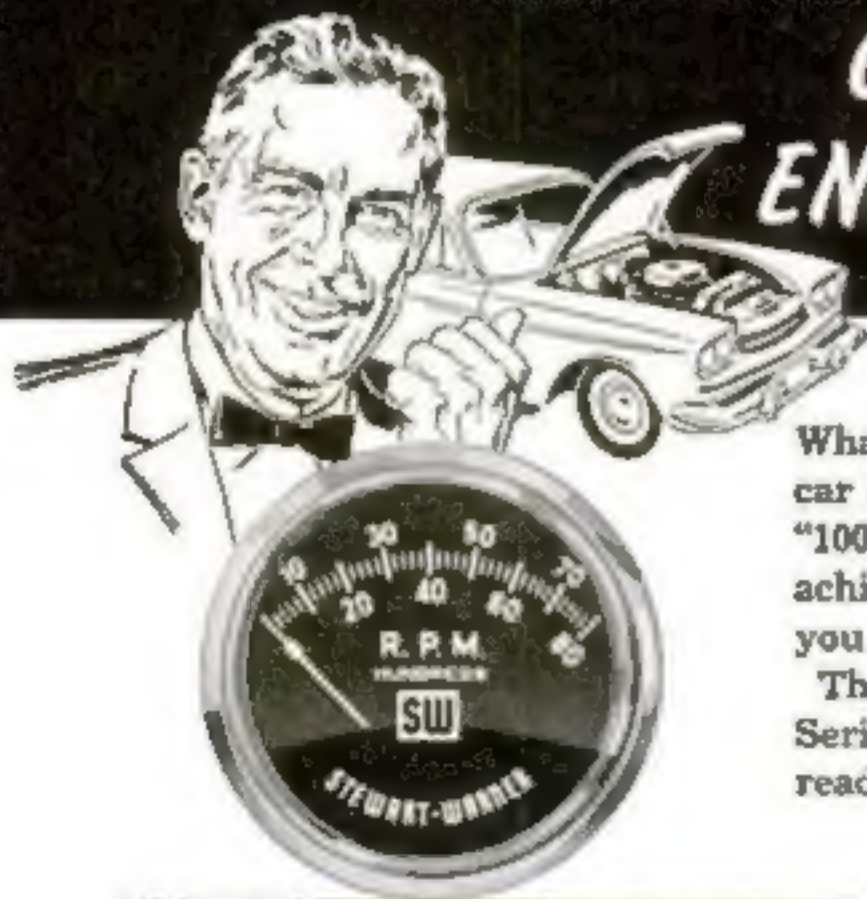
RICHARD HUGHES, Indianapolis.

Will California Be First?

AFTER your forceful reporting on speedometer rigging last winter [Jan.], you might like to know that a bill has been introduced in the California Legislature that would require an odometer seal on all vehicles registered after Jan. 1, 1962. It would also require a report to the Department of Motor Vehicles of breakage of the seal, and of the odometer's repair within 30 days if this oc-

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curred; and would make driving without the seal, breaking or removing it, or changing the odometer reading a felony.

Since California has started the ball rolling, perhaps other readers might want to prod their own states to take it from there and stamp out the practice of odometer rigging.

GEORGE CRAWFORD, Oakland, Calif.

... THERE'S one way to stop used-car frauds by dealers ["Can We Stamp Out Speedometer Rigging?" Jan.]: Have the owner of each car report the odometer reading each year on his application for car license so it can be recorded on his registration. States with car inspection could include an odometer test.

CLARENCE NORTON, Barronett, Wis.

... PUT me on record as endorsing any workable plan to ban speedometer rigging. And add still another gripe: Many total-loss insurance claims are rebuilt and sold to the public as first-class merchandise. Let's have these cars branded for safety's sake.

A. H. JAMES, Fort Worth.

The Better Way

THE Short Cut writer who designed a "Shelf for a Typing Table" [Feb.] had a good idea, but after copying it I soon found he'd stopped work too soon. Or maybe I'm not built right. Anyway, I



sawed out a half-moon section on the front edge and now I have room for my scarred shins. There's still room at the back for books or a box of typing paper.

ALFRED WEST, Orange, N. J.

Setting the Record Straight

I WAS greatly interested in your series "Straight Talk to Inventors" and delighted that you singled out our client, Nelson Stud Welding, for reference in your first article ["So You've Invented Something . . . Now What?" Feb.].

Just for the record, I think you will

CONTINUED

Are You "STANDING STILL" on your job?

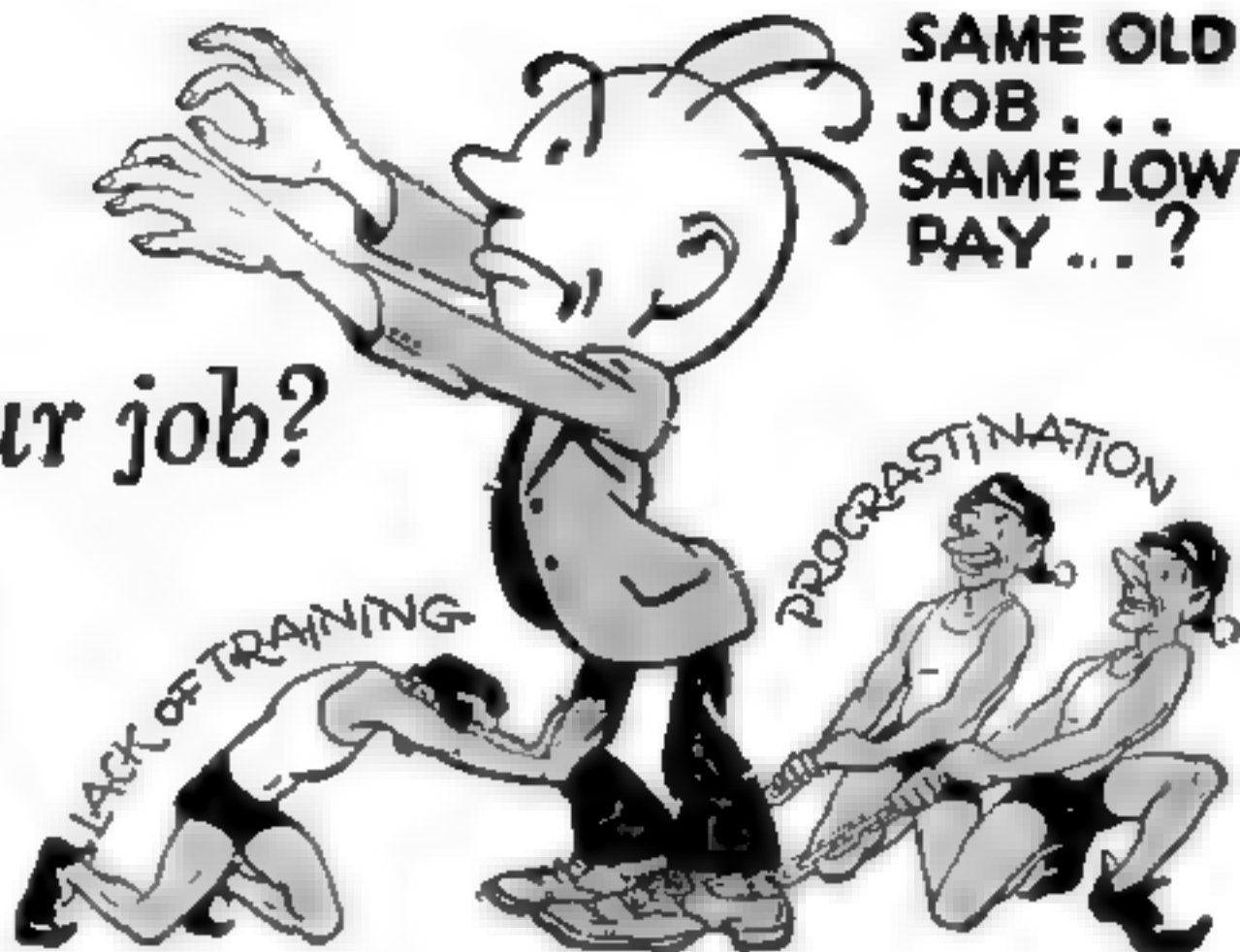
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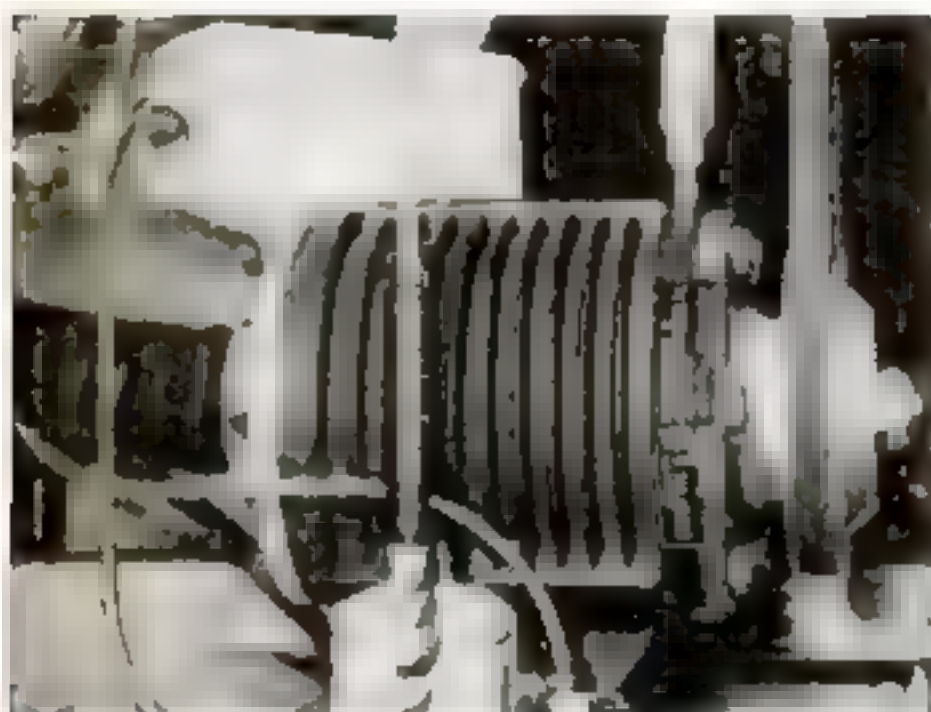
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ANSWERS: 1. Supercharger, to give extra power

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QUAKER STATE OIL REFINING CORP., OIL CITY, PA.



want to know that the inventor to whom you refer was Ted Nelson, not George Nelson. Confusion may come from the fact that George Gregory is president of Gregory Industries, Inc., which acquired the Nelson Stud Welding business from Ted Nelson in 1948.

The purchase price was not \$15,000,000, but \$242,000 plus a promise to pay Nelson 2½ percent of the company's gross income from business based on his stud-welding patents and related developments.

PAUL L. EDEN

Eden & Associates, Cleveland.

Throw Away That Rule

JUST read about the fellow who built a chest to fit between dormer windows ["My Most Embarrassing Shop Moment," Feb.], only to find it was one inch shy in all dimensions because he'd forgotten he'd cut off the tip of his rule.



My maxim is never to use a rule when you can avoid it. If he had taken scrap wood strips and cut them to size on the spot where the chest was to go, and then used these to indicate the cuts to be made in his shop, he would have ended up with a chest that fit exactly.

I've also found it is often difficult to measure the position of holes to be drilled for mounting hardware or other equipment. Take a piece of paper, punch the exact location of the holes, and use this as a pattern. There are many other problems of measurement that can be solved—and solved better—without a rule.

A. B. CRAIG JR., M.D., Rochester, N. Y.

PS Goes Abroad

WITH your permission, we've already distributed reprints of your booklet "What to Do When Your Car Conks Out" [July '57] to our members, and included it in our Road Atlas and Touring Guide of South Africa. Now an editor of a medical journal in this country asks



Pontiac's new Tempest coupe is here.

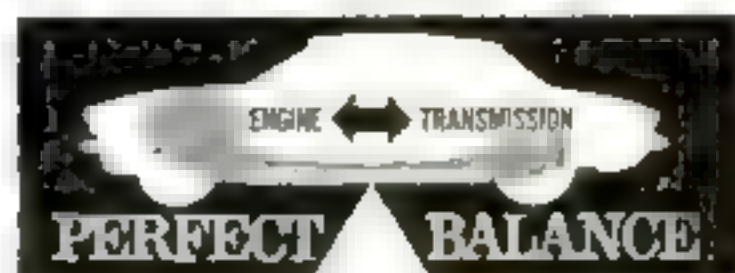
(Straight six-passenger model or custom bucket seat version)

Two sharp new coupes join the Tempest sedan and station wagon. Shorter roof lines. Longer rear decks. The custom coupe has a town car rear window, full carpeting, sports-type bucket seats. Both have independent suspension at all four wheels. Swing axles. Engine in front—transmission in rear. Big 15-inch wheels on a Wide-Track. You can cut a hairpin curve flat and steady. Call the shot on performance. A gas-saving, 4-cylinder, inclined engine with a horsepower range from 110 to 155. Drive the new Tempest coupe. It's priced with the compacts.

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permission to use the material, too, with the usual acknowledgement.

H. J. KLEYNHANS
Automobile Ass'n of S.A.
Johannesburg, S.A.

Permission granted. This material was also used by the U. S. Information Agency in Indonesia, reprinted in that country's language

Pakistani Radio Built in Flint

I CHOSE your candle-powered radio [Nov.] for a Science Fair project and thoroughly enjoyed working on it. I picked up the parts at a radio store for about \$5. An old auto aerial serves adequately and wax vigil-light candles generate power.



RON RICE, Flint, Mich.

Likeness Only Skin Deep

You say the XM79 grenade launcher [Jan.] was developed by the Springfield Armory and the Picatinny Arsenal. Away back in October, 1943, you showed the same weapon—except that it lacked distance sights and used a grooved grenade

M. ROUBICEK, Nahariya, Israel.

S. D. Long's grenade gun of '43 resembled the Army's new XM79 externally, but was designed to fire a fragmentation grenade similar to the familiar hand-thrown "pineapple." Ammunition for the XM79 is of a special design. Details concerning it are still classified.

On Drying Out Tail Lights

DRILLING holes in tail-light lenses to drain off water ["Hints from the Model Garage," Feb.] is certainly a bright idea! The bottom hole would drain off any water, all right, but all the hole in the top would be good for would be to admit more rain water plus dirt and dust. If the manufacturers thought two holes would be advantageous, they'd certainly have put them there when the car was built.

G. G. GEORGE, Bowling Green, Ohio.

Without an air inlet, no water would



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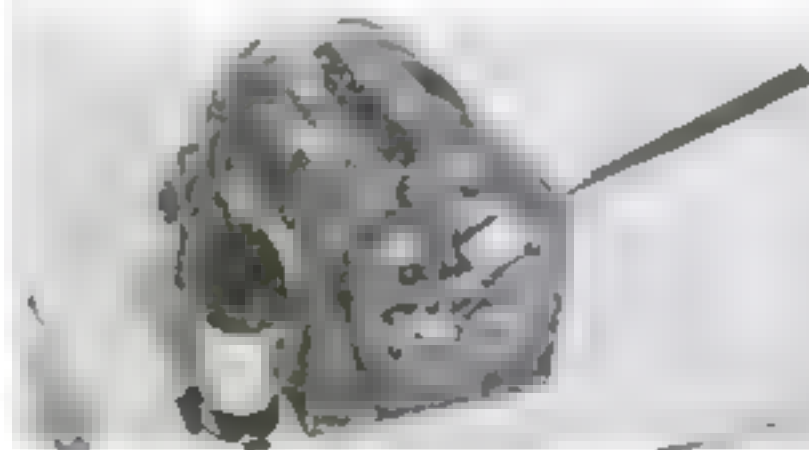
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drain from the $\frac{1}{8}$ " bottom hole. Little moisture could make its way into the light through a $\frac{1}{16}$ " air-inlet hole.

Swiss Try Hand at Rotary

THE Germans aren't the only ones working on rotary engines. My brother and I have designed two. The first one used normal auto-engine valves to transfer gases from the impeller side to the combustion chamber. Our second, more compact, engine has a displacement of about 200 cc. and gives one power stroke per revolution.



The picture shows, on the left, the carburetor and ignition coil; at right, the exhaust stack. The gears at center turn the bypass shaft.

We build engines in our spare time, and it took us 1,200 hours over a span of eight months to complete this one. Performance is still not to our satisfaction—it takes high revs to start it.

O. AMREIN, Basel, Switzerland.

He Knows His Megacycles

MORE states should follow Connecticut's lead on their highways ["Catching Drunk Drivers Before They Kill You," Mar.]. I enjoyed the article very much but, being an amateur radio operator, I am sure the car-to-car channel can't be 29.23 megacycles as you say. That's in the middle of the popular 10-meter amateur band. Probably this should have read 39.23 since that frequency is in the public service band.

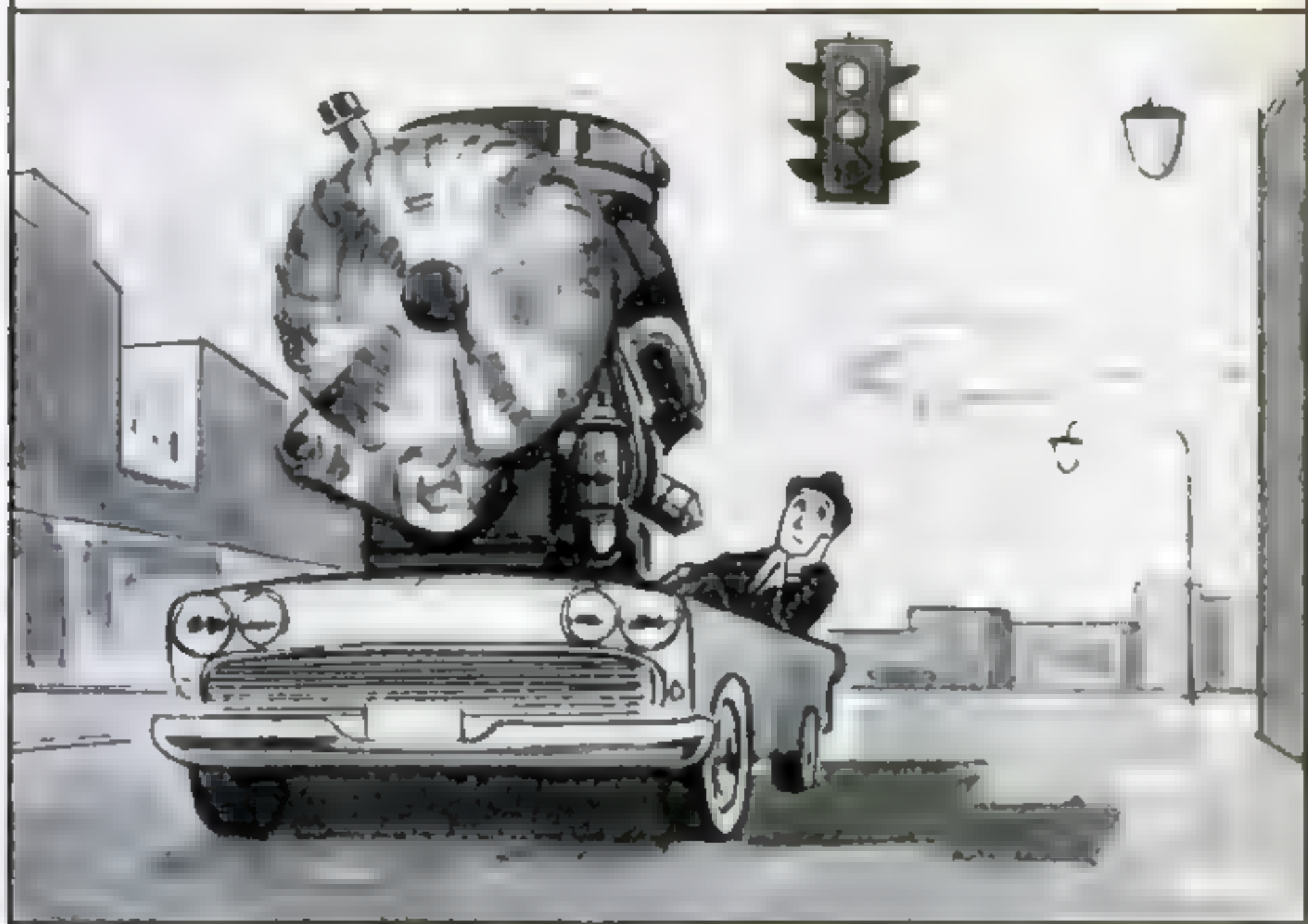
D. L. BARQUIST, Rockford, Ill.

State Police Lieut. J. Francis O'Brien tells us we were in error. Station-to-car or car-to-car frequency is 39.50 megacycles; car-to-station is 39.26 megacycles.

Paging All Inventors

I've set up my own lighting plant. I took an old generator from a car, put

What to do about engine wear...



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Your engine is just “waiting” to wear out

What “oil tests” don’t show is what happens to your car engine during idling and in ordinary, everyday driving. Only about 1/10 of your horsepower is used! That means incomplete gas combustion, sludge on vital parts—and excessive wear for your engine!

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a propeller on its shaft, and mounted it on a 30-foot pole. I ran the wires to an old battery. From there the electricity goes through a voltage regulator and an inverter that change it to 110 volts AC. When the wind is blowing right, the set-up charges the battery and gives me enough current to light six 50-watt bulbs and play the radio.

But I want to utilize any wind. How can I mount the generator (with a tail fin) to revolve into the wind without



the wires twisting around the pole? Maybe some of your basement inventors can help me.

J. H. LINTON, Steinhatchee, Fla.

Americanizing the Imports

I'M CONFUSED. The engine displace-

ments of American cars are always given in cubic inches, those of foreign cars in cubic centimeters. How do you convert them back and forth to compare them?

ORDWAY EDWARDS, NYC.

To find out how many cc. in an American engine, multiply its cubic inches by 16.39. (Example: For the Oldsmobile F-85, 215 cu. in. multiplied by 16.39 is 3,524 cc.) To convert a foreign engine's cubic centimeters into cubic inches, multiply by .0610. (Example: For the Volkswagen, 1,192 cc. multiplied by .0610 is 72.71 cu. in.)

Any Rock Hounds in the House?

I WONDER if any of your readers have ever built any kind of tumbling barrel for polishing rocks? Rocks are my hobby.

J. A. LANG, Anacortes, Wash.

But Where Would He Store It?

I HAVE decided to come to the rescue of Wordless Workshop before it's too late. Your pipe-smoking handyman with the forelock has made so many racks for storing things (in December umbrellas,

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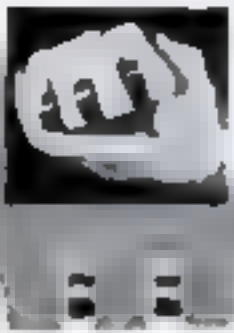


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Just as Safety Discs in fist (above left) keep fingers apart, so over 1000 Safety Discs in each Armstrong Tire keep tread's gripping edges apart, always ready to grip — no matter how hard you brake!

But fingers of fist without discs (above right) can squeeze shut. That's why ordinary tires, lacking Safety Discs, can squeeze smooth and slippery under braking pressure — and you skid.

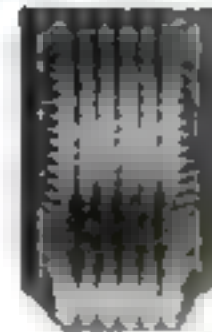


Grip in all directions!

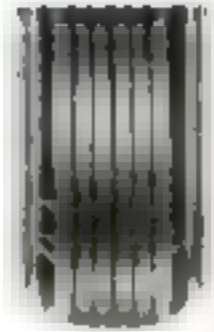
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but before that bicycles, milk bottles, plants, etc.) that he can't miss with just one more. His tidy spouse would be absolutely stiffened by a Storage Rack for Storing Storage Racks.

Then he could turn his talents to something really useful, like a pen wiper made from old socks, or an ancient Egyptian water wheel for bailing out wet cellars.

ALBERT A. SIMMS, Seattle.

Understudy for Gus?

READING one Gus story—my favorite piece—resulted in a very neat coincidence a few months ago. I had just read about Gus doing a job on a gas tank crushed by air pressure due to poor venting, when I went off on a visit. My host, worried about his car, talked of running out of gas in an odd manner. After quizzing him, I figured that his trouble was an un-vented gas cap. We checked, and sure enough it was! I felt like Gus in person.



GERARD LIETZ, Notre Dame, Ind.

Nailing with Clamps

CLAMPS are one of the most useful tools in my shop. I use them often to press nails in where quarters are tight, or where a hammer blow might damage the work. If the nail is to be clinched, use a small block of wood on the rear to allow the nail point to penetrate, then remove the block and bend over the nail point with the clamp.

A large-throat clamp can often substitute as a vise where the available vise jaws will not open far enough. Fasten the clamp in the vise and you're in business.

C. H. HUFF, Cedar Rapids, Iowa.

One Man's Heat...

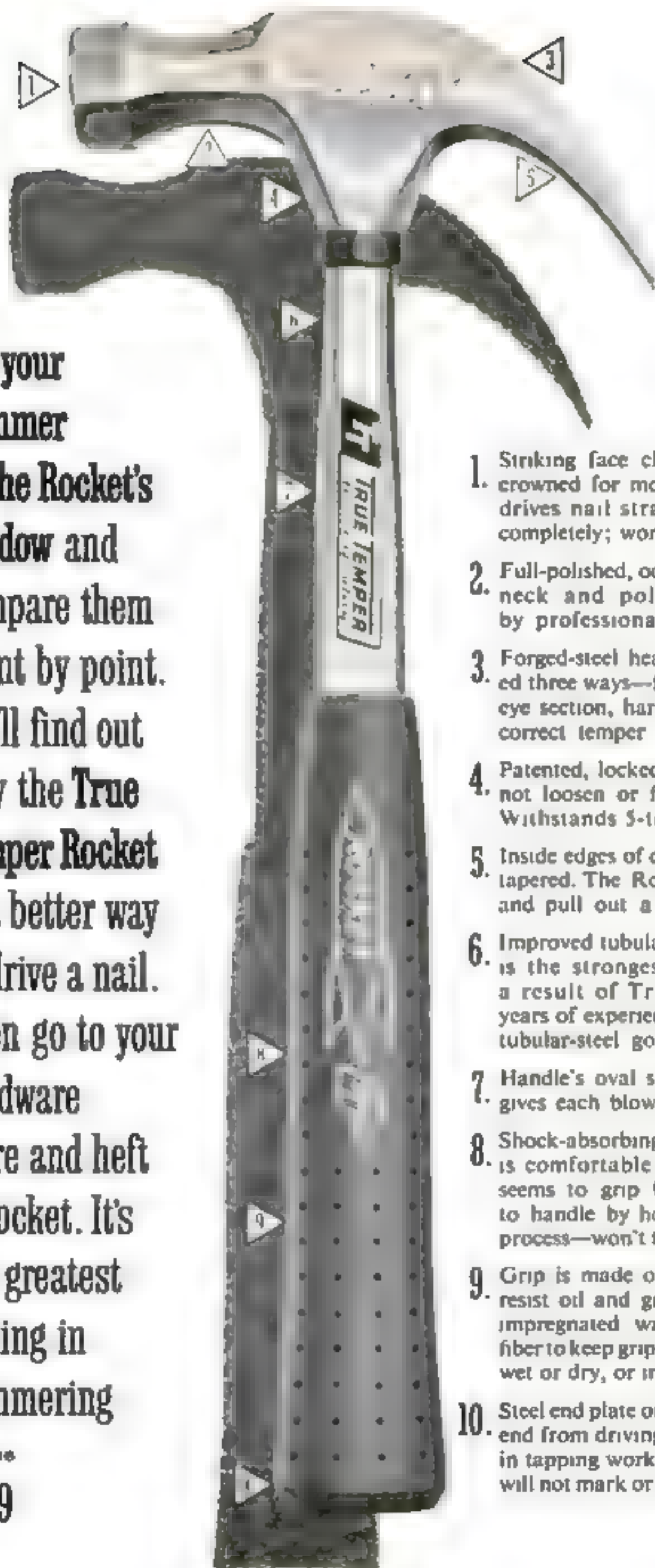
IN CASE any readers are planning to install heating plants over the summer, I'd like to get in on that argument on oil heat vs. electric heat ["PS Readers Talk Back," Feb.].

We have a frame house with storm windows, uninsulated except the attic floor, and hot-water, oil heat. This is a 5,000-degree-day area and in our 2,000-sq.-ft. house, we use less than 1,000 gallons of oil a year. That gives us a con-

Lay your hammer in the Rocket's shadow and compare them point by point. You'll find out why the True Temper Rocket is a better way to drive a nail. Then go to your hardware store and heft a Rocket. It's the greatest feeling in hammering

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5. Inside edges of claws precisely tapered. The Rocket will bite and pull out a *headless nail*.
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7. Handle's oval shape actually gives each blow more power.
8. Shock-absorbing cushion grip is comfortable and lively—seems to grip back. Bonded to handle by hot vulcanizing process—won't turn or loosen.
9. Grip is made of neoprene to resist oil and grease, and it's impregnated with pulverized fiber to keep grip from slipping, wet or dry, or in gloved hand.
10. Steel end plate on handle keeps end from driving through grip in tapping work. Cushion end will not mark or damage work.

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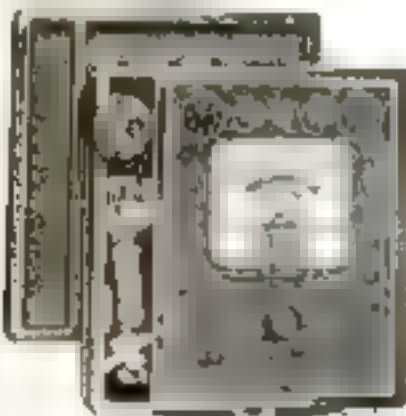
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stant 73-degree temperature inside for about \$150.

Mr. Conaway lives in a 6,000-DD area, so using his figures it would cost us about \$600 a year for electric heat, even with his two inches of insulation. Without insulation, wow!

R. A. MILLER, Ridley Park, Pa.

... A FEW qualifying statements to strengthen letter-writer Conaway's point:

With flameless electric heat, the oxygen within the home is not consumed by the heating system. This being the case, the industry firmly recommends, regardless of climate, six inches of ceiling insulation, three inches for outside walls, two inches for floors.

Local economics should be considered before choosing one fuel over another. In my state, electricity is cheap and natural gas is an imported product.

Regardless of the degree days of heating required in an area, the proportionate costs of fuels remain constant. Mr. Conaway's state [Indiana] has been a leader in electric heating, and I have an idea that studies there have proven the economic feasibility in many cases.

COY C. JORDAN, Raleigh, N. C.

No Rock, Just Roll

Your description of our self-propelled vacuum cleaner ["New Ideas from the Inventors," Mar.] gives a false impression. It is not necessary "to rock the handle." The cleaner is a powered device and the motions used in vacuuming a rug are those normally used, but with practically no effort. The invention is comparable to power steering in a car.

CLARA DOSTAL, Great Neck, N. Y.

A Movie Screen for Every Car

ABOUT a year ago [Apr. '60], you reported on a patent for a drive-in theater system that would rotate reels of film to various projectors.

I have just been to a theater in Buffalo, Mo., where each car had its own screen and one projector served all screens simultaneously. It's all done by a very ingenious arrangement of specially ground mirrors, an inch by a half-inch in size. Hundreds of these are placed at many and very precise angles.

J. W. COMEWELL, Oskaloosa, Iowa.

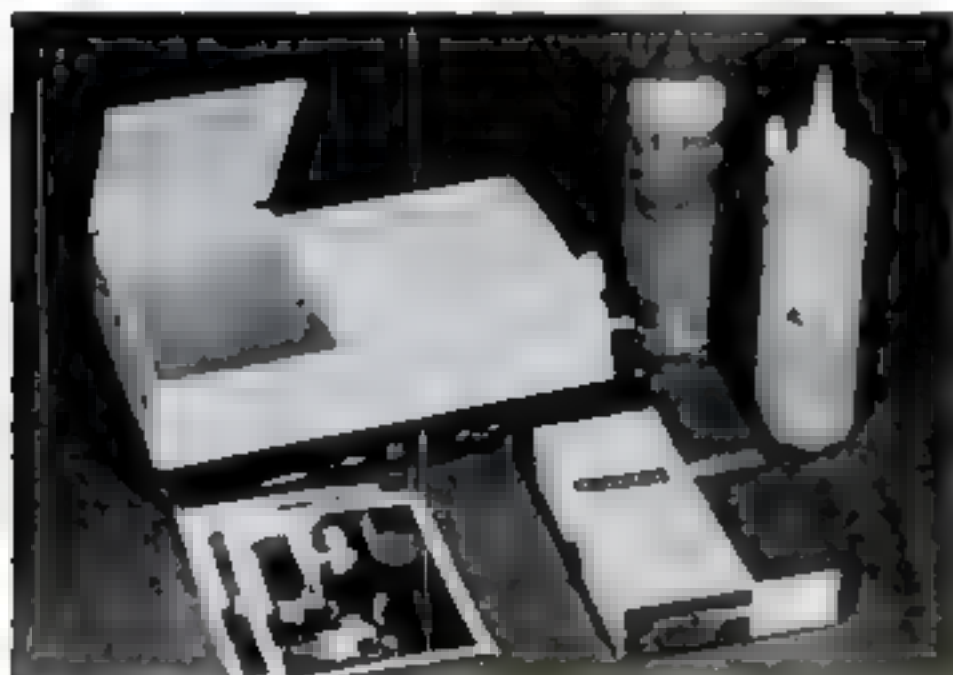
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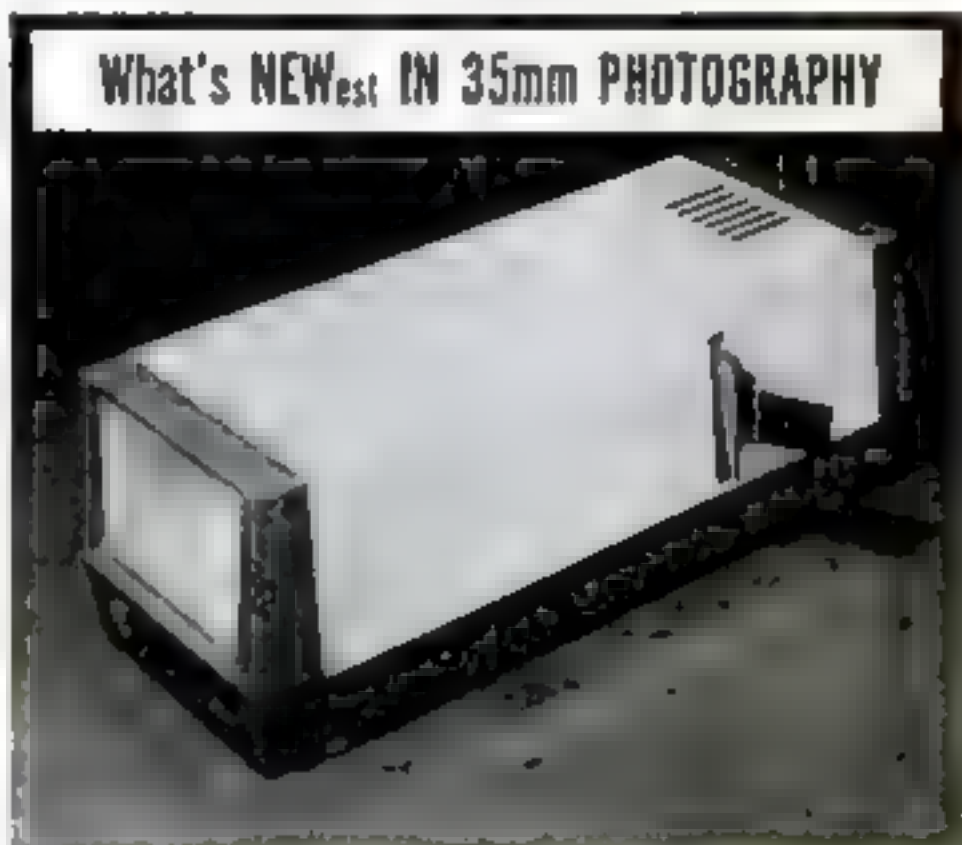
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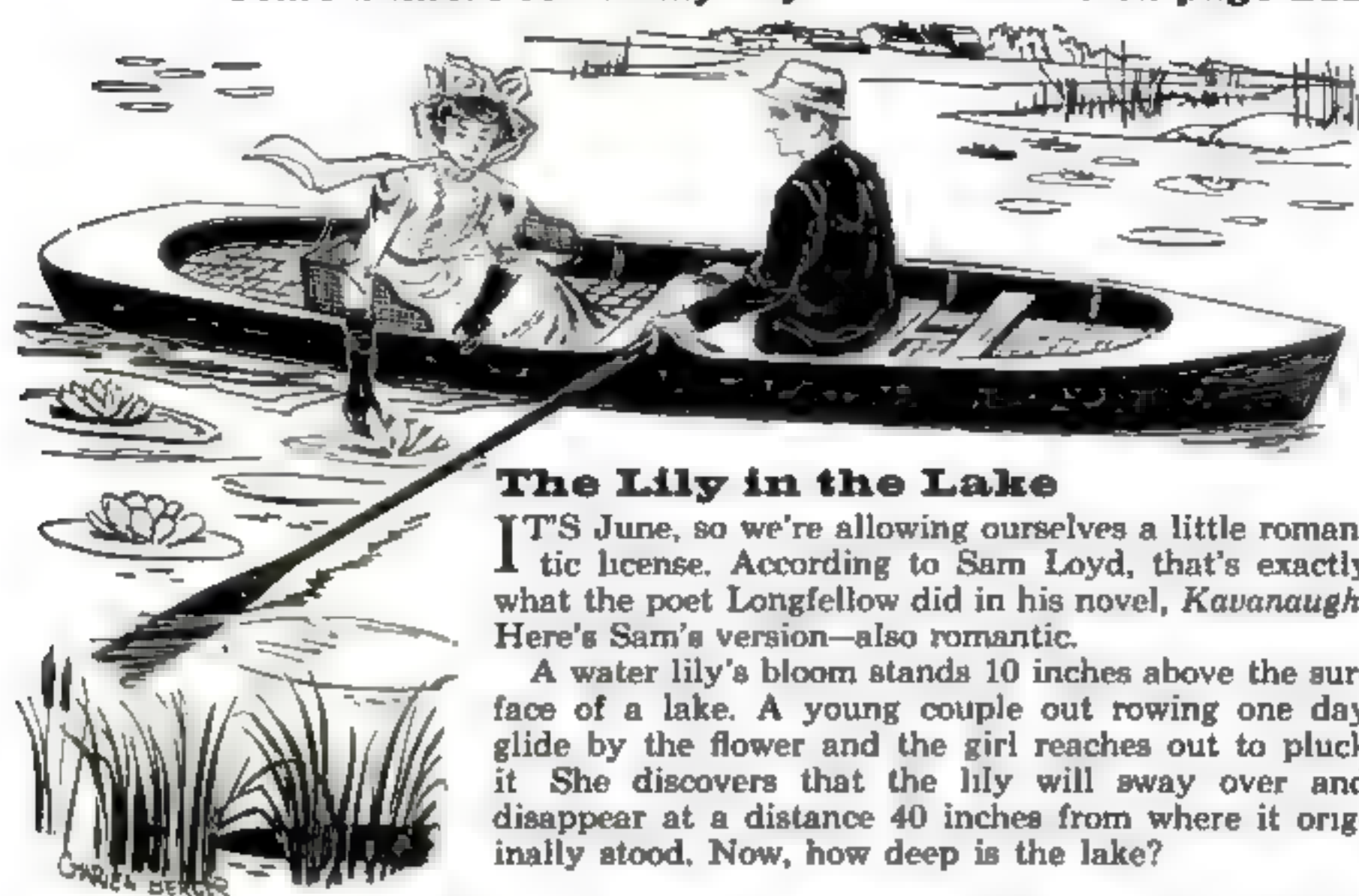


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The Lily in the Lake

IT'S June, so we're allowing ourselves a little romantic license. According to Sam Loyd, that's exactly what the poet Longfellow did in his novel, *Kavanaugh*. Here's Sam's version—also romantic.

A water lily's bloom stands 10 inches above the surface of a lake. A young couple out rowing one day glide by the flower and the girl reaches out to pluck it. She discovers that the lily will sway over and disappear at a distance 40 inches from where it originally stood. Now, how deep is the lake?

I HAVE no business giving you verbal teasers in writing but these may be good ammunition for torturing friends:

"How do you pronounce t-w-o?" you ask.

"Uh-huh, now how about t-o-o?"

"Now, how do you pronounce the second day of the week?"

And this one:

"How do you spell the English word meaning a group of people, often used in conjunction with dancing or singing to describe native arts?" (F-o-l-k.)

"And the white of an egg?"

We won't insult you with the answers.

A TWIST on a logical whodunit this month: Four men, one of whom was known to have committed a crime, made the following statements to the police:

Archie: Dave did it.

Dave: Tony did it.

Gus: I didn't do it.

Tony: Dave lied when he said that I did it.

If only one of the four statements is true, who was the guilty man? Now suppose only one of the four statements is false. Then who did it?



THE Case of the Hard-Boiled Egg has me intrigued by coincidence again. I met this puzzle twice this month: once in Kenneth Swezey's fine book, *After-Dinner Science* (McGraw-Hill), and once in a lecture by a distinguished oceanographer. It's the old problem of how you tell—with no props (and no breakage)—the difference between a raw and a hard-boiled egg. I bet your wife knows.

CONTINUED

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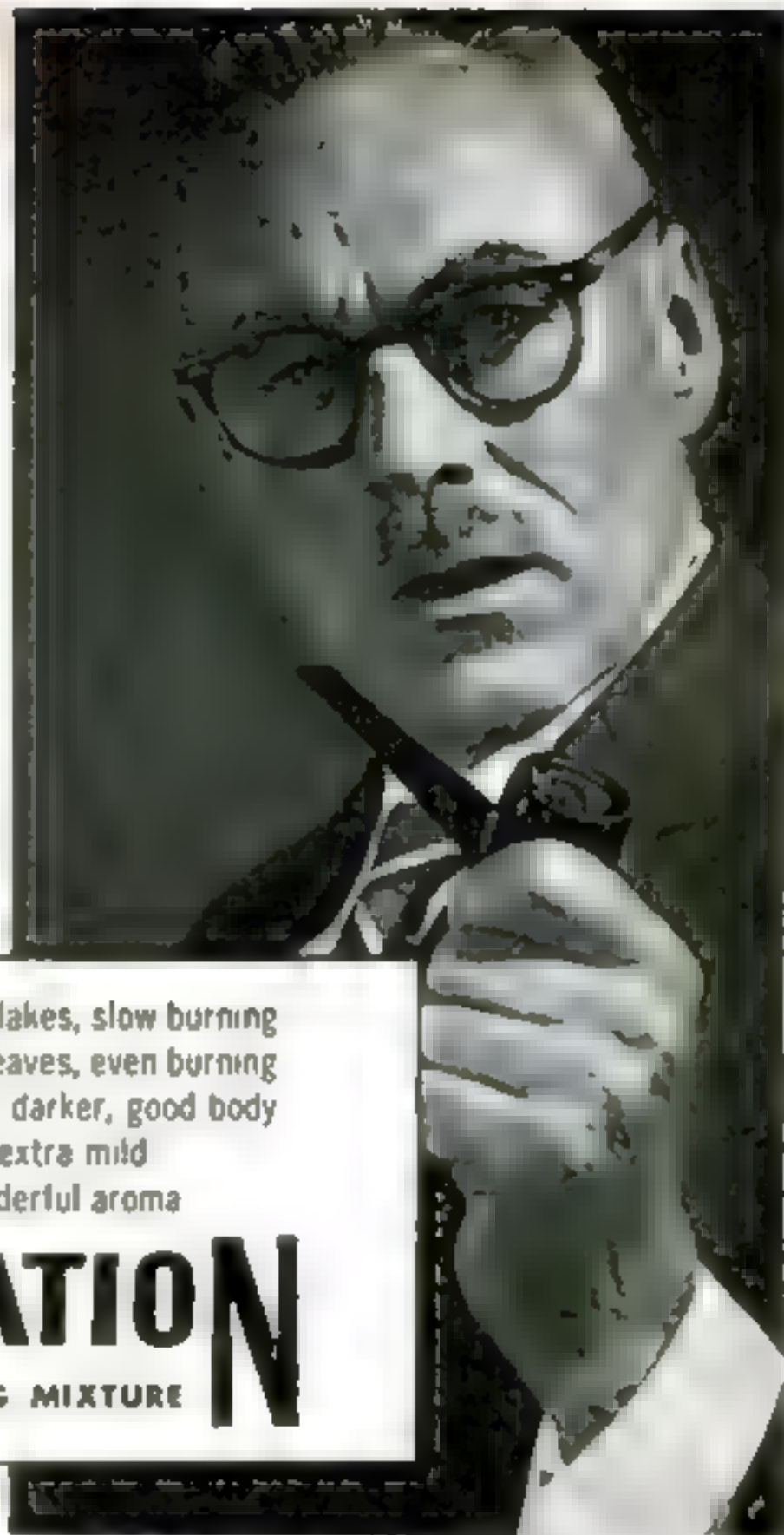
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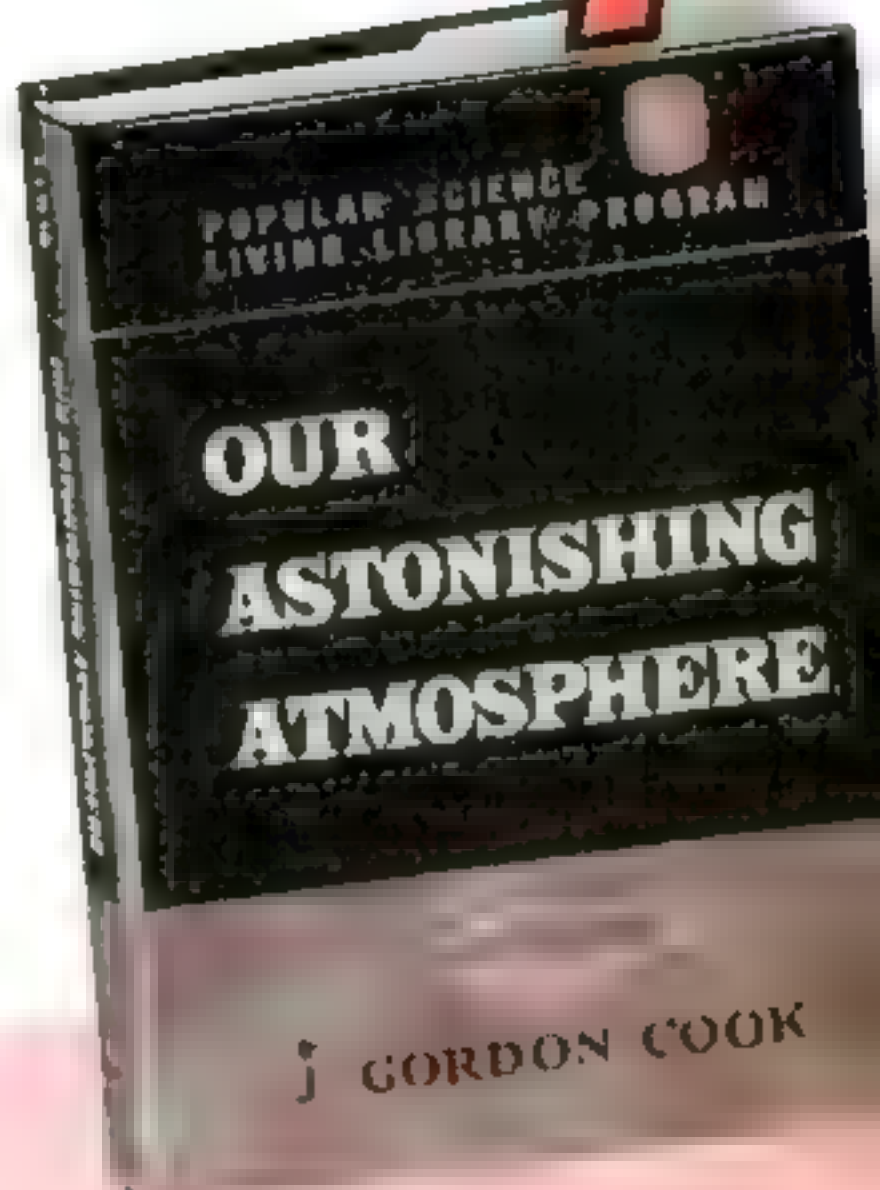
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PS Puzzlers continued

HOW many of you know the hard-to-believe facts about the "Birthday Problem"? The question is simple. Suppose for the sake of argument that births are equally spaced at all times of the year and that you sample a group of people at random. How many people would you have to ask before your chances of finding two with the same birthdate were greater than fifty-fifty? 25? 50? 100?



I TRIPPED up on a part of this puzzle. Can I help it if I'm no good with a gun?

Our old friends Tom, Dick, and Harry were a mile at sea in a small boat when they were fired on by a rifle from the shore. Tom was the only one to see the smoke from the gun. Dick just heard the report. Harry happened to notice the bullet glancing off the water. In what order did the three witness the event?

Puzzle of the month



HERE'S a weight puzzle that I never did lick and I blush to admit how many leisure moments were devoted to it. I'll tell you this much: There is a pattern. The problem is to select four weights of varying sizes that will allow you to weigh all integral amounts from one to 40 pounds on a scale balance. You can stack any number of known weights and the unknown weight on either side of the balance, in this way making use of all the various sums and differences of the numbers involved. (Answer next month.)

Answer to last month's P.O.T.M. You were asked to drill a six inch hole through a solid sphere and then compute the volume of material remaining.

It doesn't make any difference what size the sphere is. The restriction that the hole be six inches long—and go clear through the sphere—demands that the hole's diameter increase as the sphere's diameter does; thus a constant volume of material is left— 36π cubic inches.

Let R =radius of sphere, r =radius of hole. Then the volume of the sphere= $\frac{4}{3}\pi R^3$

and the volume of the cylinder ($V=\pi r^2 h$) is $6\pi r^2$. But by the Pythagorean Theorem $r^2=R^2-9$, so the volume of the cylinder is $6\pi(R^2-9)$. The formula for the volume of the cap can be derived by calculus but it's a standard one: $V=\frac{\pi h^2}{3}(3a-h)$ where

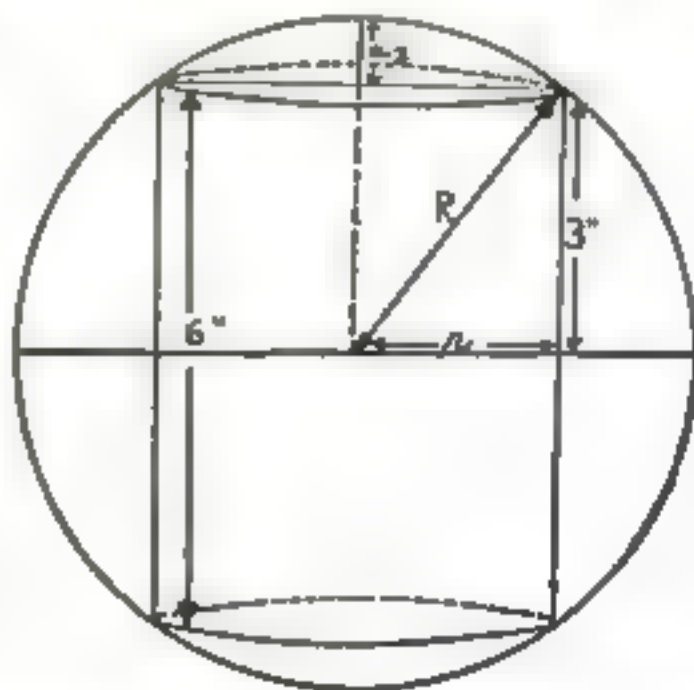
a is the sphere radius and h is the height of the cap. Here $h=R-3$ and $a=R$ so the cap volume= $\frac{\pi}{3}(2R^3-9R^2+27)$.

If we subtract twice that amount (for top and bottom caps), and also the cylinder volume from the total volume of the sphere, all the factors involving the sphere

and hole radii cancel out in this fashion.

$$\begin{aligned} &\frac{4}{3}\pi R^3 - 6\pi(R^2 - 9) \\ &\quad - \frac{2}{3}\pi(2R^3 - 9R^2 + 27) = \\ &\cancel{\frac{4}{3}\pi R^3} - \cancel{6\pi R^2} + 54\pi - \cancel{\frac{4}{3}\pi R^3} \\ &\quad + \cancel{6\pi R^2} - 18\pi = 36\pi \text{ cu. in.} \end{aligned}$$

Incidentally, the volume remaining is exactly the volume of a sphere with diameter equal to the length of the hole!



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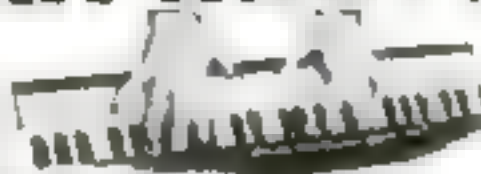
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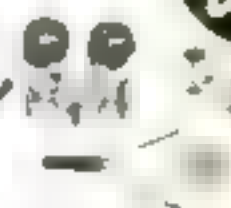
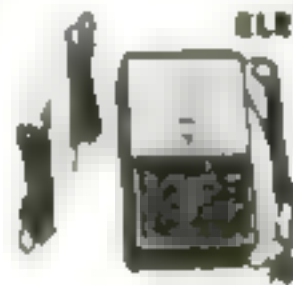
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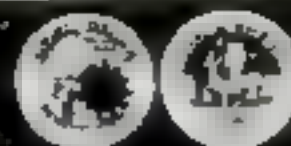
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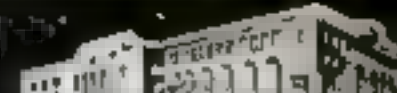


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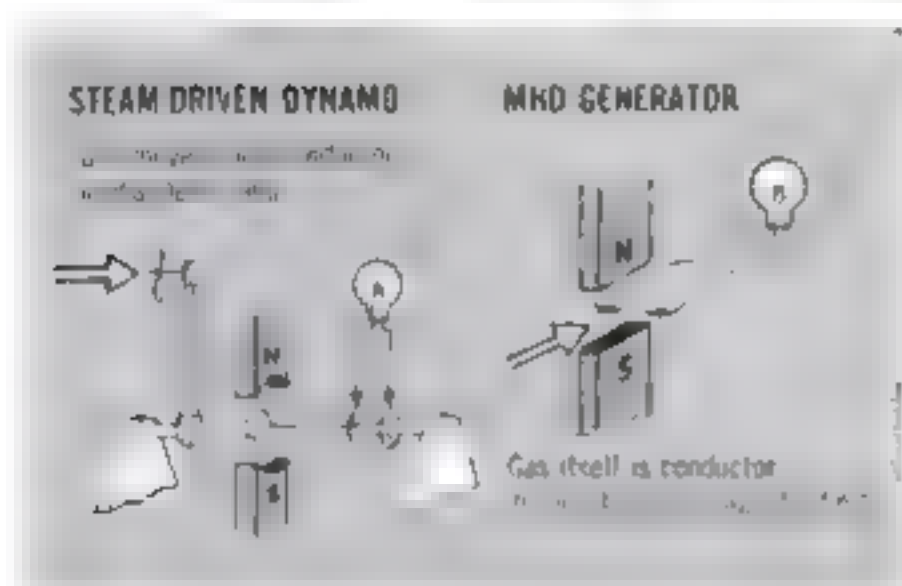
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ONE

6

The month in science

DC from a gas jet. Of all the new and far-out schemes for generating electricity, the hottest (figuratively and literally) is MHD, short for magnetohydrodynamics. It involves no moving machinery, but gets kilowatts directly by burning cheap fuel (coal, oil, gas, or whatever you have handy) and should cut the cost of power.

The MHD generator works like the trusty old dynamo: You move a conductor through a magnetic field, and the magnetic field pushes electrons (the stuff of a current) out of the conductor and into the power lines. The difference is MHD's moving conductor. It's no basket of wires, like a dynamo armature, but a stream of gas. The gas comes directly from the burning fuel and becomes a conductor when heated hot enough—to around 5,000 degrees F.



Then its atoms are shaken so hard that electrons come loose and can move around. In the MHD generator, this ionized gas passes between the poles of a magnet. The magnetic field pushes the freed electrons to one side, where they are collected by a contact and fed out to run motors, lights, and toasters. MHD electricity is direct current, and has to be changed to AC for the customers.

Big problem has been the 5,000-degree temperature. This has been eased somewhat, in experimental work conducted by Avco and a group of utilities, by enriching air with pure oxygen to make the fuel burn hotter. The problem of building units to stand up under prolonged operation at 5,000 degrees is still formidable. Avco's newest generator, which has a magnet with 22-ton copper windings and 25-ton iron poles, can produce 500 kilowatts—for one minute at a time.

Full-size plants, when they come, should be 25 to 40 percent more efficient than steam-driven turbine-generators. In the utility business, where a difference of hundredths of a penny can break you or make you rich, that's Real Big.

On the trail of the living spacemen. Solid evidence that life exists outside the earth is piling up. It comes from a rather unlikely source: meteorites, the mysterious hunks of rock that flash across the sky as falling stars and hit the earth.

Three separate research teams have now found traces of life inside meteorites. The most recent discovery is the most startling: meteorite dust that grows into living bugs (at least, that's what they look like under a powerful microscope; the longest measures only .000016 inch).

The space bugs were found by two government scientists, Dr. Frederick D. Sisler of the Geological Survey, who has been

The month in science continued

hunting meteorite life for six years, and Dr. Walter Newton of the National Institutes of Health, an expert on growing things inside sealed cabinets that are absolutely free of ordinary germ contamination. They sterilized and ground up a meteorite that fell in Kansas 11 years ago. It was a rare type known to contain carbon, the element essential to living matter (most meteorites are iron minerals, without carbon).

Their first experiments drew a blank. They injected bits of the dust into germfree rats, mice, and chickens. Nothing happened. But when they incubated some of the dust in a salt-water-and-sugar solution for a couple of months, the solution turned cloudy. Under the microscope, Dr. Sisler saw what looked like "sausages you might have twisted, thrown on the floor, and jumped on." These bugs have now been transferred several times to fresh, sterile test tubes. Each time they multiplied—strong evidence that they are some kind of living things.

Did the space bugs really come from space? This meteorite was a fresh one, and extremely dense. It seems unlikely that earth organisms could have seeped inside it. And the bugs do not look like known forms of earth life. Still, they could be.

The first hint of living matter in meteorites was discovered nearly two years ago by Dr. Melvin Calvin of the University of California. He found forerunners of life: chemicals that go into genes, the carriers of heredity in earth plants and animals. More recently, three New York chemists—Drs. Bartholomew Nagy and Douglas J. Hennessy of Fordham University, and Dr. Warren G. Meinschein of Esso Research—extracted specks of wax from a meteorite that had sat on a shelf at the American Museum of Natural History for 60 years. The wax is remarkably like the natural wax on the skins of apples and grapes. The meteorite, they feel, could not have been contaminated because it was composed of soluble salts; moisture would have made it fall apart.

Most scientists maintain their customary skepticism. It is impossible to prove positively that these meteorites did not pick up their life dust here on earth. One way to settle the doubt: send up a satellite to grab a meteorite still flying through space, seal it inside a sterile can, and bring back the package to earth. By the time that can be done, human astronauts may be scraping moss off Martian rocks. Or we may get a radio message from space creatures who are not only alive, but intelligent enough to say, "Hello down there."

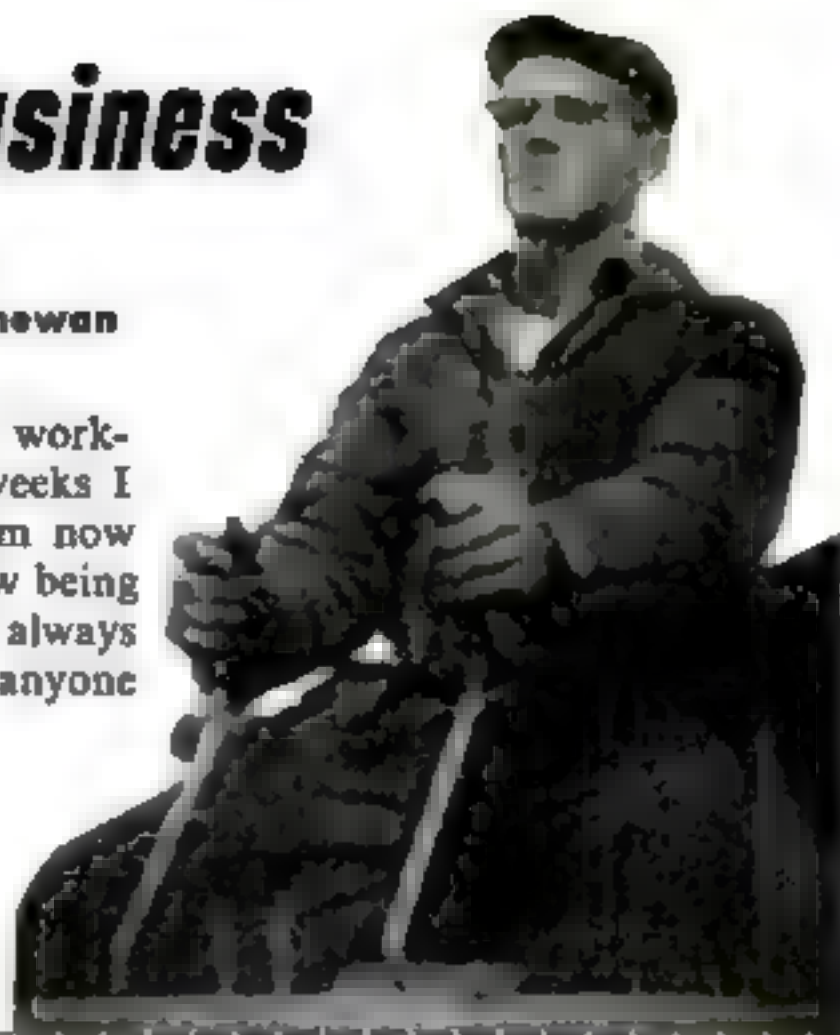
Stealing food from squirrels. It was all in the name of science. Dr. Theodore N. Tahmisian of Argonne National Laboratory, abetted by forest rangers, would wait around giant redwood trees until a squirrel knocked a seed cone down. Then he'd snitch the cone.

Dr. Tahmisian used the seeds to check the effect on living things of prolonged exposure to atomic radiation (cosmic rays and such)—those redwoods are 2,000 to 4,000 years old. The squirrels gave him seeds he could match with a particular tree—and he didn't have to climb up 250 feet to get them.

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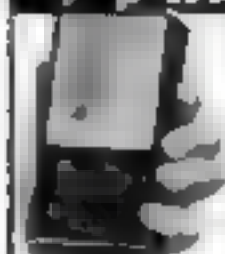
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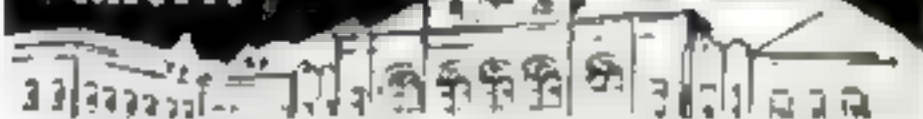


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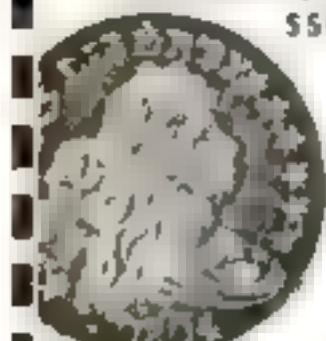
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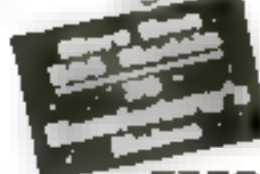
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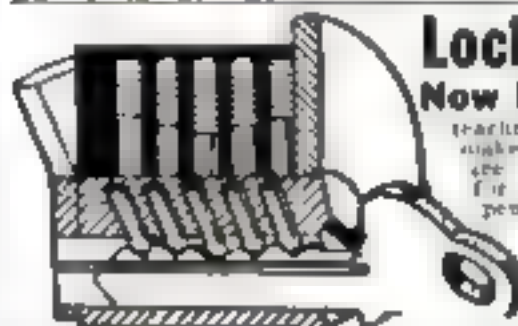
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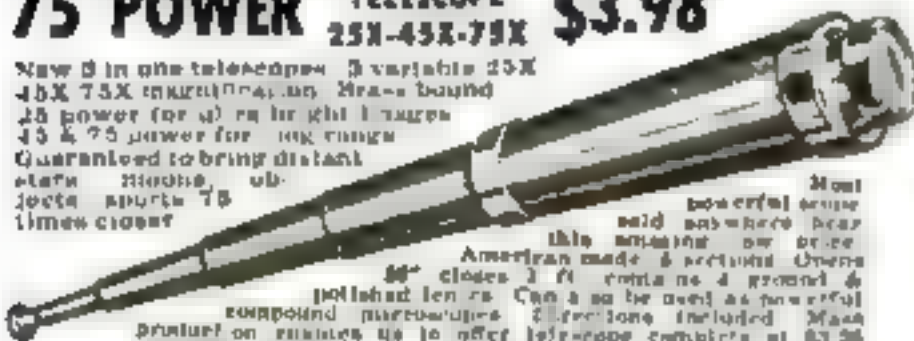
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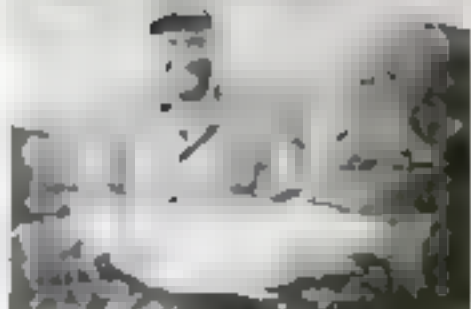
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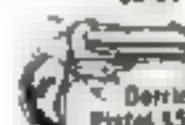
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DETROIT REPORT

By Devon Francis

At Last, a V-6 for Passenger Cars

COME next fall when the trumpets blare for the 1962 models, look for at least one and possibly three new aluminum V-6 engines. It (or they) will appear on Detroit middle-priced compacts, replacing the aluminum V-8s now being

offered to car buyers. Production lines have already been set up under high priority. As of mid-spring, the only thing that could go wrong is some unforeseen difficulty in producing them in sufficient volume and quality.

Still another compact on the way. Add another "senior compact" to the two that are being readied by Chevrolet and the Ford Division for announcement this fall ("Detroit Report," March). It's to be by the Lincoln-Mercury Division, and will fit in between the Comet's 114-inch wheelbase and the Mercury's 120-inches. Working title of the new car: "Canadian Y."

The smaller Merc—by whatever name it assumes eventually—will not differ much in size and mechanical equipment from the Ford Division's "Canadian X." As against the latter's 115½-inch wheelbase, the "Y" will have one of 116½. Chevy's senior compact, slightly smaller, will offer a straight six and a V-8 as options. Currently it's dubbed the H-35, and when it joins the GM family may be christened the Corsair.

In case the public isn't already confused enough by the presence of so many compact cars in the automobile showrooms, the additions for the 1962 model year will bring the total to 14. All told, this will represent a buyer's smorgásbord of 27 brands of domestic cars, not counting Chevy's sporty Corvette. That's eight more than the spectrum showed in 1959, the low-point year in buyers' choices for the last decade.

The H-35 will have a unique suspension in back—a spring with only one leaf. Chevy is adopting it—for this car only—because it reduces car weight by 20 pounds and offers a softer ride.

Other motor makers are dubious about driver reaction to a skinny-looking spring. Yet Ford is reported to be making eyes at the idea, possibly for one of its 1962 models.

Amber to turn? Detroit has launched another of its cooperative car-lighting research programs. The manufacturers are now testing amber-colored turn signals,

more quickly spotted than red ones. Another idea being explored is an increase in the intensity of the brake lights for daytime driving.

Offbeat designs. The 1963 Chrysler Corp. cars—they're only 16 months from introduction—are expected to have left-

of-center fins and other unbalanced items, somewhat like the Plymouth dream car unveiled a few months ago.

That American Volkswagen. You can forget Ford's version of the sub-compact VW until the spring of 1962. Despite

reports to the contrary, the company's four-cylinder, front-drive Cardinal is nowhere near the production stage.

Up wagons, up convertibles. At last fall's National Automobile Show in Detroit, manufacturers' agents button-holed motorists, asking what their next

car would be. The compiled results, now made public: hardtops down 7 percent, other sedans down 17½, station wagons up 8.7, convertibles up a whopping 13.



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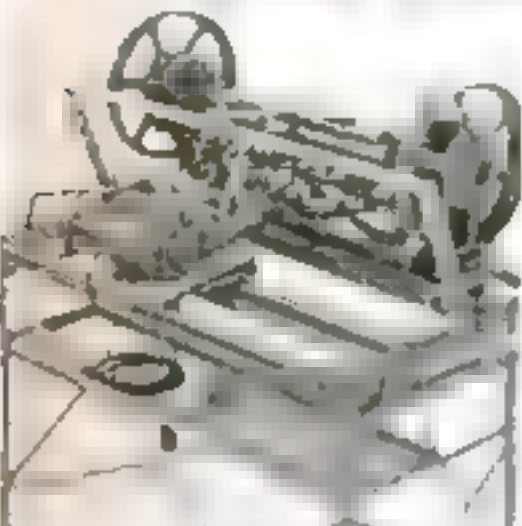


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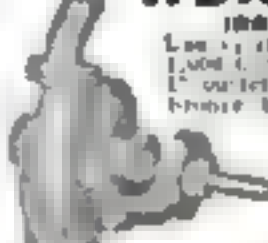


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Highway engineers have staged ferocious crashes. Their findings are startling

**POPULAR
SCIENCE**
Monthly

How Dangerous Are Guard Rails?



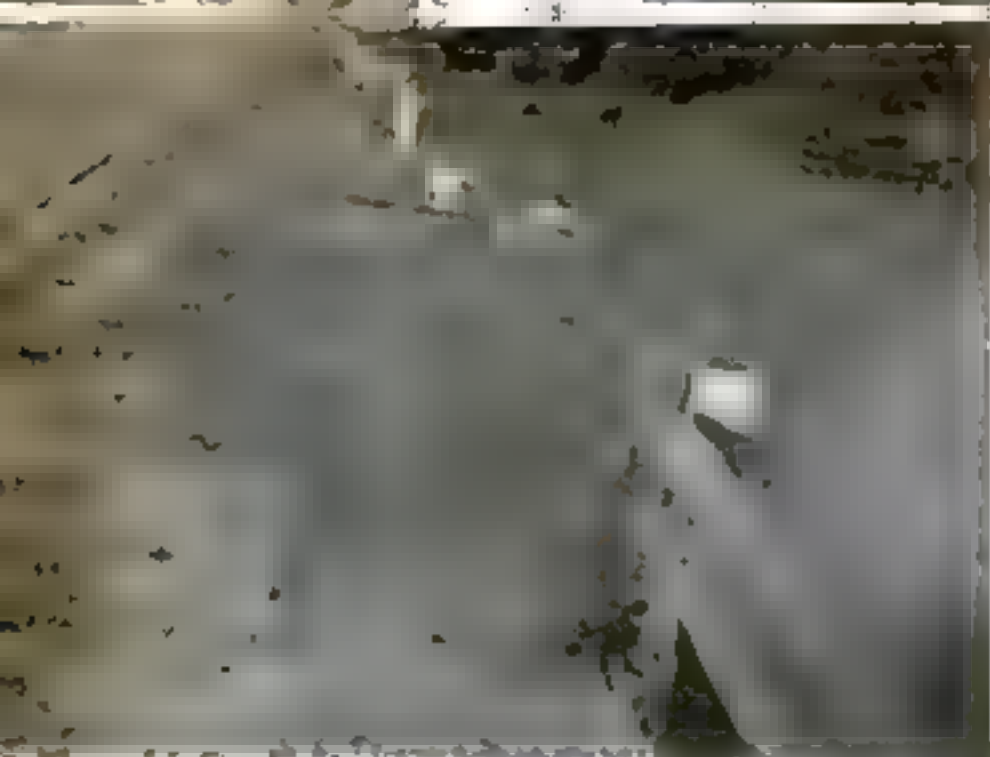
THE next time you are tooling along a highway, take a hard look at the guard rail flicking past. If it seems reassuring steel and concrete, sturdy and capable—imagine this scene:

A hundred yards ahead of you, a car

is rolling along at the legal limit of 65 m.p.h. Suddenly a wasp flies in the vent pane. Startled and swatting wildly, the driver lets his car veer off the road. It strikes the guard rail. What happens?

For your answer, there's no better

CONTINUED



THREE-CABLE GUARD RAIL was vaulted in this high-speed crash. Better anchorage of the upper two cables might have snared the car.

source than engineers who have been staging heavily instrumented and sometimes terrifying tests of just such circumstances. First (of course) they will tell you they can't be specific: "An accident like this is a complicated series of interlocked events, occurring milliseconds apart." All right, you say patiently, first split your hairs and then explain what *probably* happens.

● *Possibility No. 1.* The car may tear up the rail and pass over it. It will then go on to strike, still at high speed, whatever is beyond. While this can happen with any rail, it is least likely with some of the newer designs.

● *Possibility No. 2.* The car may deflect the rail and abruptly "pocket"—bull its way into a bulge in the rail. Or perhaps it will snag a wheel rim on a post. At 65 m.p.h. either eventuality may produce savage, perhaps lethal, decelerations. The car may slam around 180

degrees, or roll over, or vault the rail, or slide back onto the road.

● *Possibility No. 3.* The car may deflect the rail a foot or two and then slide along it, smashing posts and tearing up its side. Its riders will certainly be shaken up and probably injured.

If these macabre estimates make it sound as though guard rails kill more people than they save, the impression is wrong. Yet much recent research suggests that guard rails are really desperation measures. And that little-recognized details in their design can be crucially important.

There's one hopeful sign: Now, for the first time, a good deal of research and testing is going on. Many highway departments are running their own studies, sometimes with elaborate crash tests. To try out various median dividers, California highway engineers crashed dozens of radio-controlled cars. General Motors, just to develop new rail installations at its proving ground, ran off a test program of nearly a hundred instrumented crashes. Tests on this scale have already revealed information that could not have been known "intuitively" or by study of roadside wrecks.

Why leave the road? A stodgy or inexperienced driver might pontificate that guard rails are to save fools from themselves, that good drivers simply don't go careening off the highway. This is, of course, unrealistic. Cars leave the road every day of the year for plenty of reasons besides folly and drunkenness. Among them: drowsiness or "highway hypnosis"; inattention or distraction—that wasp, traffic situations—a bungled pass—or a child wobbling out on a

Almost anything can happen when your car hits a rail—

HIGH-SPEED MOVIES reveal that, at 65 m.p.h., any contact with a guard rail can prove savage. Car here "pocketed," rolled, was wrecked.

ENDS OF GUARD RAILS can be killers, even when curved for deflection. This car, a total loss, was going 49 m.p.h. Dummy took an 18-G shock.





Chain-link fence may safely soak up the Gs

SAFE STOP FROM 65: Whamming in at a 16.7-degree angle (see cover), the 4,190-pound sedan above was stopped in 93 feet. Peak deceleration inside was a momentary five Gs, average, a gentle 1.6 Gs. Car damaged 14 posts and 100

feet of mesh. Forty feet beyond crash, cable strain uprooted a concrete deadman (below, left). Damage to car itself (below, right) was moderate. GM men (who shot pictures on these two pages and the following one) put it at \$500.



biker); an unexpected patch of snow or ice; uncontrolled yawing after a swerve or after dropping a wheel over the edge; a blowout or mechanical trouble.

Statistically, these add up to a mortal

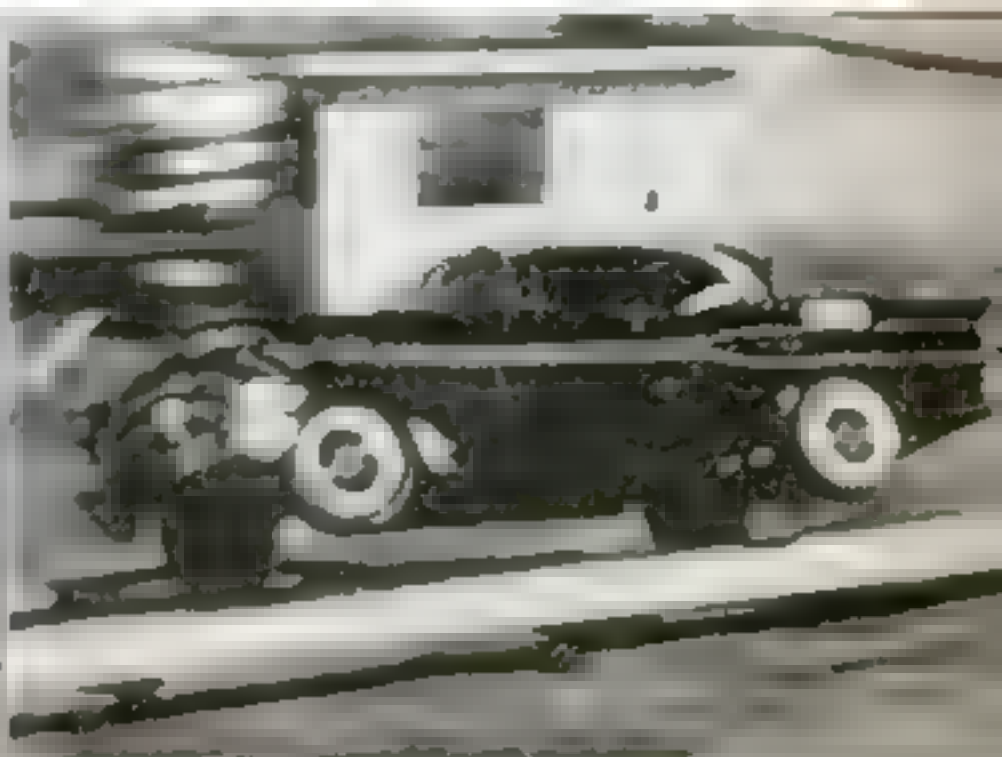
problem. The "two-car accident" has long had the most attention as the biggest highway killer. Actually, the one-car "off the road accident" is a close second as a cause of death. The nation

CONTINUED 47

but a lot depends on the car's speed

EXPERIMENTAL RAMP, 25 feet long, protected end of guard rail. This 50-m.p.h. impact suggested ramp, if not ideal, was better than a stub end.

BUT AT HIGH SPEED (here 65 m.p.h.) even a long 37.5-foot ramp tossed car violently into air. Letting posts protrude also proved dangerous.

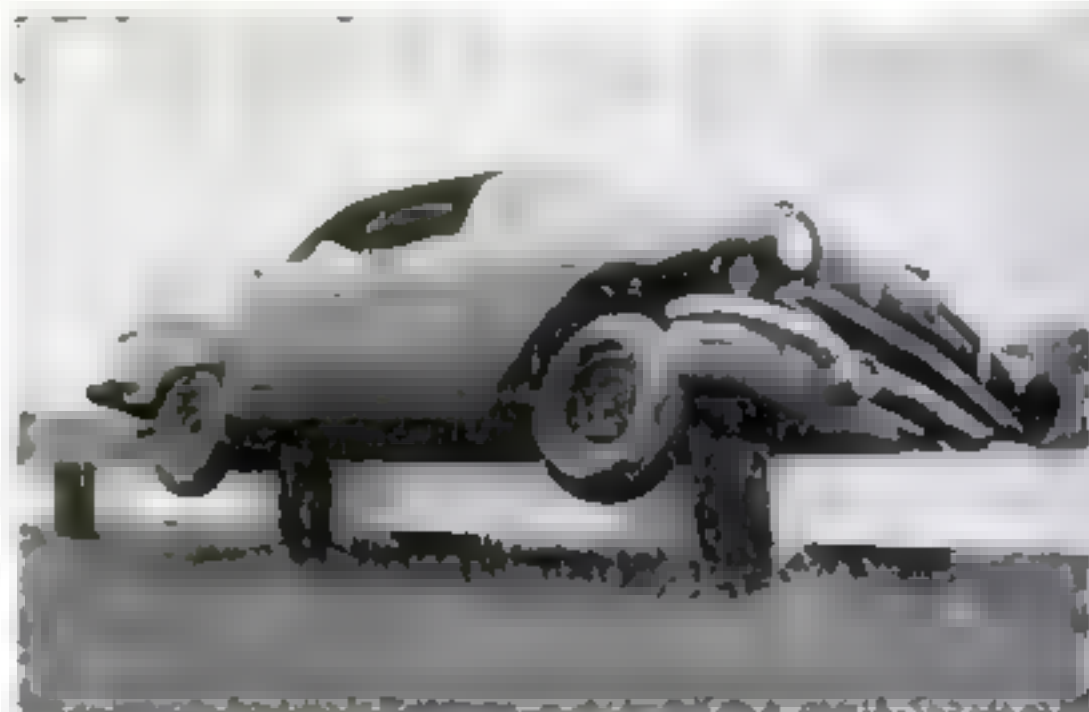




Struck at 65 m.p.h., this rail worked well. Car did not vault but clawed along until past end.



STRUCK AT 35 M.P.H., this spring-mounted beam rail guided car to a safe halt with relatively little damage to either car or fence.



FREAKISH THINGS HAPPEN even at modest speeds. Hitting at 35 m.p.h., this car climbed halfway over ribbon rail and skated along top.

Even those roadside signs can kill

Highway signs like the one at right, common all over the country, are risky to hit. Up to about 35 m.p.h. or so, the sign is simply knocked down. But at impacts of 40 m.p.h. and up, the steel post is ripped away from behind the 25-lb. metal sign, leaving it free to crash into the windshield. In GM tests, at 40 m.p.h. it caromed off cowl. At 60, it came in flat and murderous.

GM's fix has been to raise all proving-ground signs to 60 inches, instead of the standard 42-inch height. Tests show that signs now stay up in the air long enough for a car to pass harmlessly beneath it.

The solution—practical but not perfect—offers little to drivers of high cab trucks.



Standard-height sign can . . . slice viciously into a car.



If sign is mounted 18 inches higher, car passes below.

wide totals are grim: Each year off-the-road crashes kill 12,000 to 13,000 people—a third of all highway deaths.

The best guard rail of all. Engineers define a guard rail as something "to prevent a vehicle from entering an area which it cannot safely travel." Then they turn around and concede that the best guard rail is none at all—the "clean" solution is to eliminate the problem, not to improve the protection.

On a dream road, where factors of space and cost are magically suspended, unguarded lanes would have a broad shoulder. Beyond this there'd be an almost invisibly gentle drainage ditch, nothing like the tank-trap trenches now common. Surfaces would be smooth and firm, to minimize the risk of "tripping" in a skid, with subsequent rollover. For 100 feet from the shoulder, preferably farther, there would be no rocks, no posts, no bridge abutments, and no trees. (Shrubs would be permitted, if they were the kind that never grew thicker than a man's wrist.) In this broad "recovery area" absolutely nothing would be tolerated that could cause the short, savage decelerations that kill.

But this is a dream, as highway designers know well. Hilly country means cuts and fills that can't be converted into so wide a band. Bridges grow impossibly expensive if their abutments aren't brought close to traffic lanes. Houses, gas stations, telephone poles, and everything else that's fatally solid can't always be moved far back from the road. And so the guard rail—a solid but-not-too-solid stopgap—has to be strung where, in expert opinion, an off-the-road incident might be worse without it than with it.

Those car-steering barriers. But why don't they make more use of those car-steering barriers—those curved-section rails of cast concrete that are supposed to nudge a car back on the road? Engineers explain wearily that these deflector barriers, which have been repeatedly invented, work satisfactorily only in some conditions. If these conditions are not met, they can do more harm than good: They may be vaulted, encourage rollovers, or cause killing decelerations.

Apparently the only commoner question asked of guard-rail men is the one about rosebushes as barriers. Sure, you're

[Continued on page 214]

Dummy driver takes a beating in California guard-rail tests



TRAVELING AT 60, a radio-controlled car piles into a divider in tests run by California highway engineers. Car received \$900 damage; dummy inside took a peak 18-G deceleration.



LESS THAN HALF A SECOND after first contact, another radio-controlled car careens off wildly. Impacts were staged at 30-degree angle, to duplicate severest likely divider collisions.

SEVERE SIDE SHOCK to 175-pound dummy was often enough to break open the door latch, despite seat belt. Then, a few milliseconds later, the rigid rail would smash door shut, as here.





SKY WATCH heads out over the sea on anti-submarine patrol. Helium diving has shortened down time for maintenance of these blimps.

How Navy Daredevils Dive Into Gas-Filled Blimps

Nineteen years ago, in the early days of the war, a young chief petty officer undertook a highly dangerous mission at the Lakehurst, N. J., Naval Air Station. His job was to enter the helium-filled bag of a blimp and install complex electronic equipment.

Alone in the colorless, odorless gas without communication with the outside, he knew that failure of his oxygen equipment would mean death in a little over a minute. Though nonpoisonous, helium doesn't support life; breathing it causes "drowning," just as water does.

The operation was a success. At a time when every available blimp was needed for antisubmarine warfare, the "helium dive" saved the time and expense of deflating the bags and then refilling them with the costly gas.

This same officer later lost his life in a similar dive when his air hose became separated from his diving mask. After this accident, the Navy began developing new and safer diving techniques.



THUMB UP is signal that mask is free of leaks. Navy officer has closed off hose to determine if air is seeping around mask's edges.

Now, at least two men at a time enter a gas bag. And a stand-by diver with a portable air-tank back pack is stationed on a scaffold near the zippered opening, ready to enter instantly.

New equipment was designed. A face mask with a telephone unit, made by the Mine Safety Appliances Company, allows divers to communicate with each



Flying porpoises

Porpoises bound by plane from Miami to Chicago's Brookfield Zoo were laid on mattresses and swabbed frequently with water during their flight to keep their skin from drying.

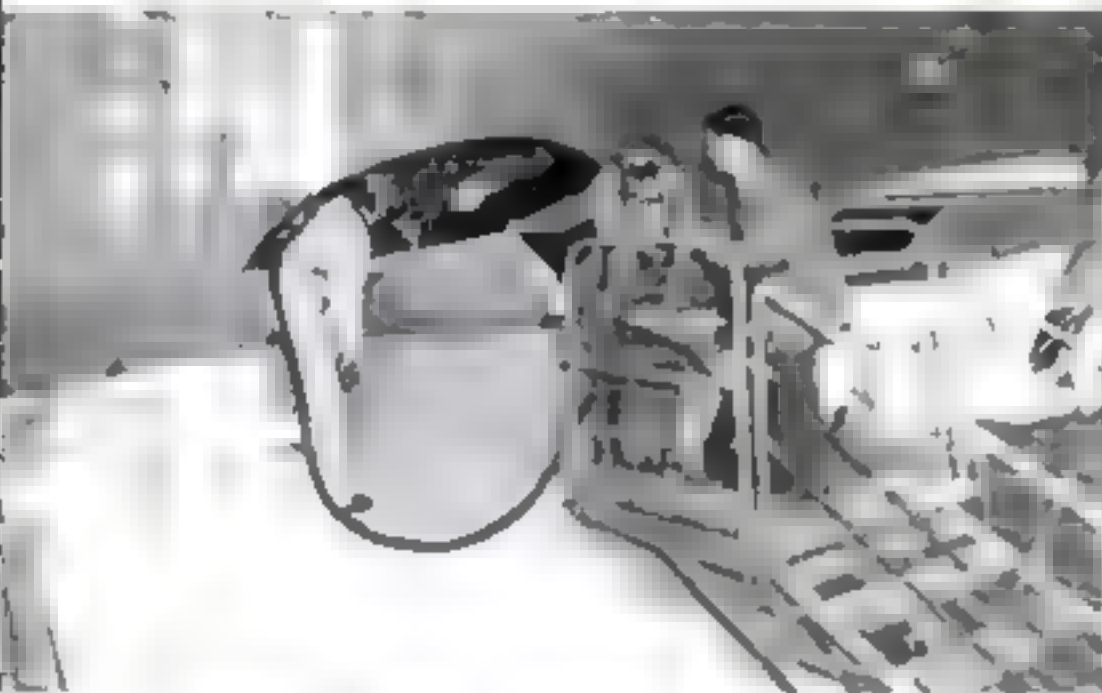
Zoo officials say the marine mammals can live 20 hours out of water but, when dry, react like people to sunburn and begin to peel. These were in their new pool in half the allotted time.



DIVING GEAR is laid out for inspection by divers before they enter a gas-filled bag. Each man usually gets 250 feet of air hose.



PAIRED DIVERS check each other's communications equipment. Mask phone is powered by sound, needs no batteries or outside power.



ZIPPERED FLAP is opened and two divers enter bag. Buddy system insures their safety. Stand-by diver is stationed on the platform.



CONTINUOUS CONVERSATION between divers and control center is the rule. Air supply comes from compressor pump near stand-by scaffold.

other and with someone on the outside. Should a diver stop talking, or should his voice become high-pitched from helium leaking into his mask, the stand-by diver comes to the rescue.

These precautions paid off recently. A diver, hoisted into a gas bag in a bosun's chair, became separated from his air hose and had time to shout only one

word: "Gas!" The stand-by leaped in, cut the straps that held the stricken diver in the chair, and carried him out with seconds to spare.

Today little has been left to chance. An instruction manual has been compiled, and dives are carried out in strict accordance with these rules. Nevertheless, it's still a job for daredevils.

Renault's new power pack

Externally the new Renault Gordini looks almost like the Dauphine; the big difference is in the engine. Redesigned valves, camshaft, carburetor, and intake and exhaust manifolds increase power 25 percent. A four-speed transmission also helps performance. Other distinguishing characteristics are rubber-protected bumper guards, vented Alfa Romeo-type wheels, and plush vinyl upholstery.



Artillery:

1. Smoothbores

Text and drawings by **Edwin Tunis**
Author of *Weapons: A Pictorial History*

BOTH sides began and finished the Civil War shooting through cast-iron cannon. Cast iron isn't the best material for a cannon; great bulk is required to make it rigid, and flaws often occur in casting it. In the 1860s, most flaws were undetectable—and flawed guns sometimes burst. Being an artilleryman had its hazards even when the enemy wasn't shooting at you.

Nearly all of these guns were smooth-bore muzzleloaders, although the Confederates had a small number of European breechloaders—the only ones in the war.

Most of the Union's large coast-defense guns were Columbiads only slightly different from those made just after the War of 1812. They had bores of 8, 10, and 12 inches. They were heavy and had considerable range: A 12-incher at high elevation could throw a 180-pound round shot three miles.

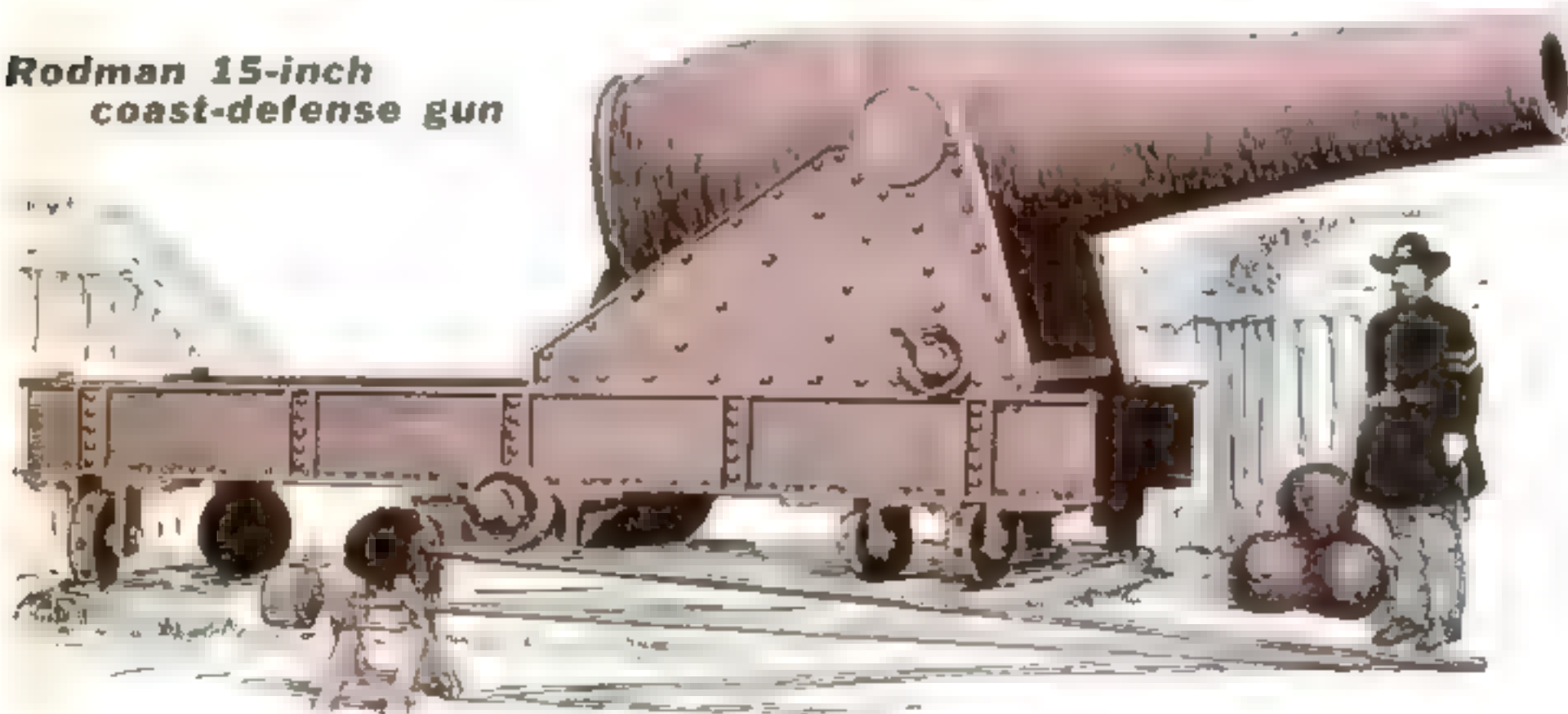
The chief improvement on such big



guns before the Civil War had been in the direction of greater strength. Captain John A. Dahlgren studied the stresses of explosion and designed a smoothbore that was very thick around its chamber. The Navy adopted his "soda bottle" (it looked like the bottles soda water then came in) and made him its Chief of Ordnance.

The Dahlgren gun had another advantage: Its elevation was controlled by a long screw run through a threaded lug cast on the breech, instead of by the wooden wedges, called quoins, that had been used since medieval days. There

**Rodman 15-inch
coast-defense gun**



WHEN CAST-IRON GUNS COOLED from the outside, the outer surface was harder than the wall of the bore, and the stresses set up in the metal added nothing to strength. Captain Rodman cast guns around a water-cooled core; the outer metal then tended to shrink and compress the bore. His guns proved stronger than

the Columbiads, though he didn't accomplish all he believed he had. Most Rodmans were used as siege and coast guns: 8-, 10-, and 15-inchers. The gun above was over 16 feet long and its thickness around the chamber was a thumping four feet. Its wheeled carriage permitted a full-circle traverse.

Second in a series of exclusive articles on the weapons that won—and lost—the War Between the States a century ago



Napoleon 12-pounder field gun moving up to the line

ON THE MARCH, the trail of the gun carriage was attached to the limber, in which the ammunition was carried. The Napoleon was bronze. Despite its small caliber and comparatively light metal,

it weighed 1,200 pounds, and six horses were needed to haul it. Two men rode the limber, and each pair of horses had its mounted rider, who sat on the near-side (left) horse.

were two Dahlgren soda bottles in the revolving turret of John Ericsson's famous Monitor.

Army Captain T. J. Rodman (they soon made him a general) attacked the problem of bursting cannon in another way, by improving the method of casting (see facing page). He also made an interesting improvement in gunpowder. When fire hit the old fine-grained powder, the whole mass of it burned in one sudden flash, giving a projectile a swift kick to send it on its way. Rodman came up with "mammoth" powder grains, cylinders three-quarters of an inch long, that exposed less surface to ignition, burned a bit slower, and gave a steady push to the round lasting all the way to the muzzle of the gun. He increased range, but he also put strains on gun muzzles that they weren't planned to take.

The Union Army had two excellent smoothbore field guns: the Napoleon, a bronze 12-pounder, copied from Napoleon III's design; and the Wiard, 6- and 10-pounders, remarkable as the one all-steel American gun in the field. These two could throw solid shot, if with dubious accuracy, better than 1,500 yards, but they were more effective firing "scatter shot"—grape and canister—something less than half that far. The Napoleon was flexible. It could shoot with the flat trajectory of a field gun or, when elevated to a high angle, serve as a howitzer.

The Germans invented the mortar in the 16th century. Its very short thick-walled barrel was mounted to point upward at a steep angle and it was fine for tossing shot high into the air to fall inside enemy defenses. The Dutch had found that bombs and incendiary shells made the best projectiles for mortars. Sparked by that old sparker, Abe Lin-

Siege mortar of Petersburg, the Dictator



THICKER (45 inches across) than long, it fired a 13-inch shell. Its first flange collapsed under the recoil.

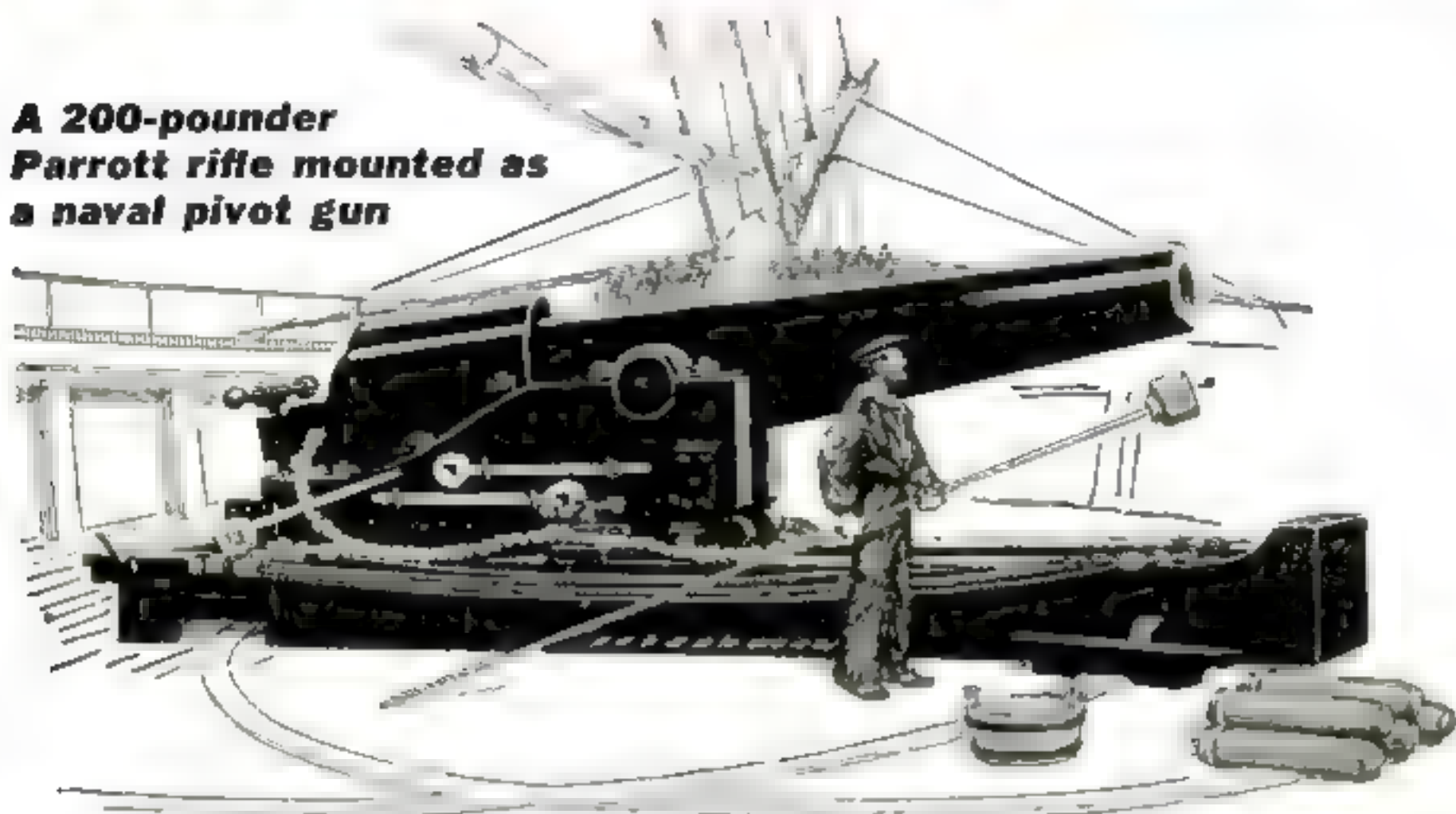
coln, both the Union Army and Navy mounted huge mortars, one to a boat, and used these gun platforms on the Mississippi River.

General Grant appreciated their value when they helped him take Vicksburg. Later, besieging Petersburg, he mounted

Artillery:

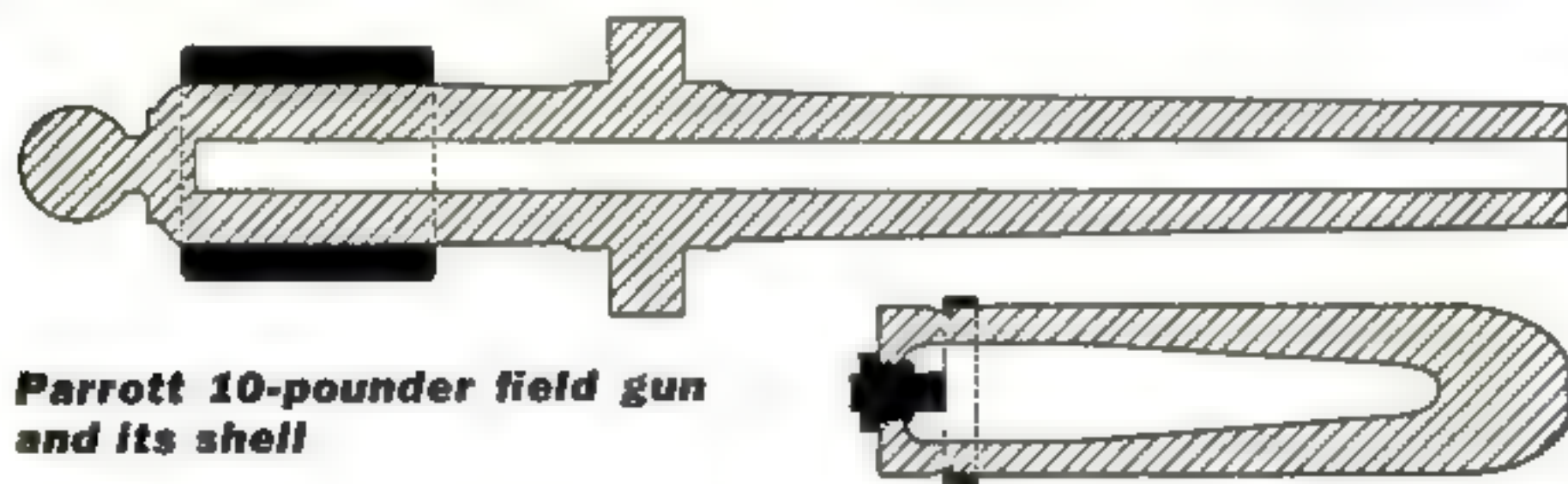
2. Rifled Cannon

A 200-pounder Parrott rifle mounted as a naval pivot gun



"SWAMP ANGEL," famous or notorious depending on your sympathies, fired from a heavy wheeled carriage. One of these bombarded Charleston from a marsh nearly four miles away. After 36 rounds, the Swamp Angel's breech blew

out and the gun jumped up onto the parapet. Perhaps it's only fair to add that excessive propellant charges were being used and that some of the incendiary shells exploded in the barrel. Illustration shows ship-mounted Parrott.



Parrott 10-pounder field gun and its shell

ROBERT B. PARROTT, a gun founder, designed and made the most important Civil War rifled cannon and its projectile. Where Dahlgren thickened a cast-iron gun for strength, Parrott reinforced a rather slender gun, also cast iron, with a forged band of wrought iron around its chamber. He did this by wrapping flat bar stock around a mandrel of slightly smaller diameter than the barrel. The wrapped metal was then heated and pounded until the bars were effectively welded into a band. Reheated, the band was then slipped on the gun barrel to cool and shrink, thus compressing the cast iron. Finally, the gun was bored to size and rifled. Parrott rifles came in 10-, 20-, and 30-pound sizes for field guns, and as 60-, 100-, 200-, and

300-pounders for use as siege, garrison, and naval guns.

The Parrott projectile was so free in the bore that if the barrel of the piece was depressed, the round could slide out after it was loaded. Parrott put a brass strip around the base of his missile and undercut the rear edge of the strip a little to let gas get under it and flare it outward into the rifling grooves. If accident moved the shell forward slightly in the gun, the air between shell and charge formed a cushion and the band wouldn't expand; then the projectile would go larruping out, end-over-end, with neither accuracy nor velocity (although the sound effects could be awesome). But careful gunners didn't let that sort of thing happen often.

a 13-incher, called the Dictator, on a railroad flatcar.

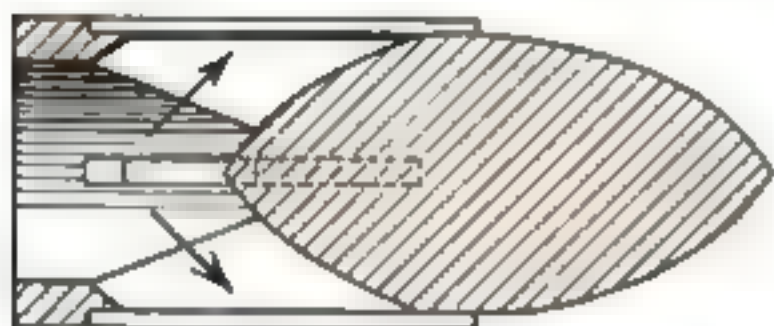
For accuracy and range, a rifled cannon, which can rotate a projectile on the axis of its line of flight, has it all over a smoothbore. Rifling is now done by cutting spiral grooves in the wall of a cylindrical bore; it was almost always done that way in the past, too. Projectiles designed for rifled cannon still have a soft-metal rotating band to grip the rifling.

With breechloaders, the grooves cut their own channels in the band, which can be larger than the bore. With Civil War muzzleloaders, however, the diameter of the band had to be a little smaller than the bore to permit loading, and the band had to be expanded at the moment of firing to make it grip the grooves. Once expanded, it greatly increased the efficiency of gunpowder by keeping gases from blowing by the projectile. Smoothbores used spherical shot, but a missile for a rifled cannon was always longer than it was thick.

Gustavus Adolphus of Sweden and Napoleon Bonaparte used their smoothbore field guns at close range to blow gaps in the ranks of infantry with grape and canister. Things changed. Civil War infantry, on both sides, had shoulder

guns good enough to keep artillery beyond scatter-shot range most of the time. Any rifled field piece far outranged even the best shoulder rifles, but a solid chunk of metal did little damage to a rank of soldiers. Only explosive shells were effective. In the wooded country where much Civil War fighting took place, gunners were hard put to aim or to get a clear shot through the trees. Rifled field pieces had uses, however, especially against opposing artillery and enemy supply lines.

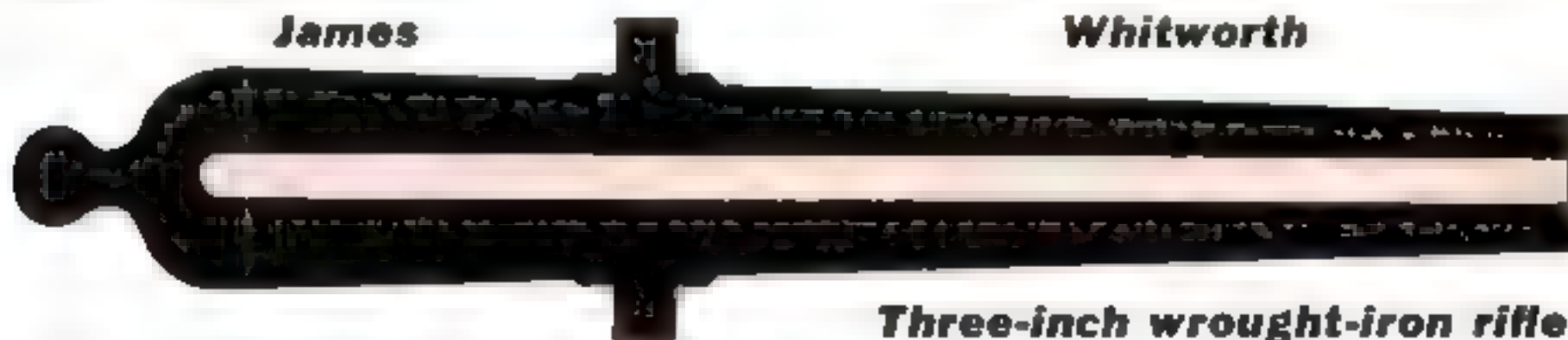
Size for size, the projectiles of rifled siege guns penetrated twice as far into masonry forts as those of smoothbores, but against earthworks neither was really much good. What damage they did to a soft earth bank could be mended overnight by the defenders. Nevertheless the rifles were the better, so there was a rush to convert Columbiads by enlarging their bores a little and broaching rifle grooves into them. Mechanics often did the job in the field with portable equipment. These conversions fired the James projectile (see below), but even with the greatly reduced powder charges that rifling permitted, the internal pressures sometimes burst the old guns after a few rounds. ■ ■



James



Whitworth



Three-inch wrought-iron rifle

CHARLES T. JAMES' PROJECTILE (above, left) served the big converted siege rifles and the three-inch wrought-iron rifle. A deep depression in the base of his shell was slotted to allow gas to press outward against the sheet-lead sleeve that surrounded the base of the projectile, forcing it into the rifling.

Both the Federals and the Rebels used the English Whitworth rifle, but most of these weapons were with the South. This was the only rifle that had no grooves; instead, it had a hexagonal bore made with a slow twist and it fired a slug

(above, right) that had six spiral flats to match the sides of the bore.

The three-inch wrought-iron rifle (bottom) fired a 10-pound shot to twice the range of a Napoleon, or about 3,000 yards. It was light and tough, so good, in fact, that it stayed in use through the Spanish-American War. Reliability came from its built-up construction. The founder wrapped sheets of boiler iron on a mandrel and rolled them hot to weld them. Then he bored the piece, turned the outside smooth, and rifled the inside. It was strictly a field gun.



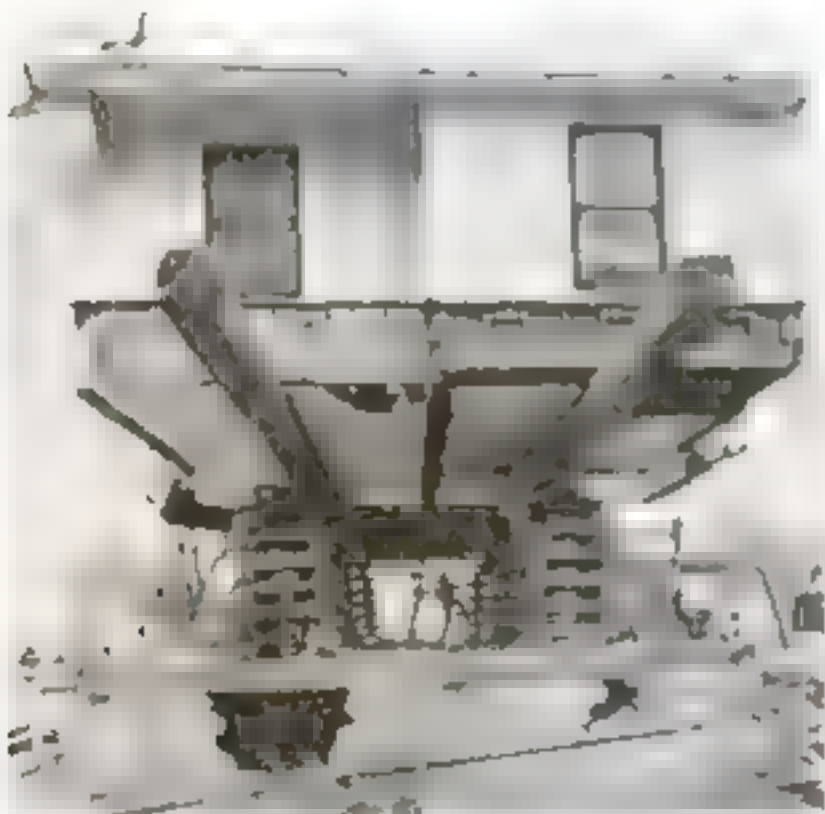
Marines undergo trial by dunking

The Marines are trying out a new device for teaching helicopter-borne troops and crew to get out—quickly and safely—from a craft ditched at sea. A modern version of the old witch's chair in which suspects were submerged until they renounced witchcraft, the trainer consists

1. **IN FOR A DIP:** Marines, fully equipped for combat, climb into copter fuselage. Once in their places, they fasten seat belts.

of a lifting and lowering mechanism, a boom, and a mock HUS-1 copter fuselage. Without requiring recanting of black magic, it works on the same principle.

Dumbo the Dunker holds 10 combat-equipped Marines plus pilot and co-pilot. When they are strapped in their seats,



Something missing here

House movers dismantled the bottom floor of a home in Topeka, Kan., propping the upper story on wooden beams to haul it to another location. The owner is converting the top into a ranch house at a new homesite.



Too tight for comfort

The sporty little Triumph TR 3 above wasn't slung quite low enough. It failed to make the grade when the driver of a big trailer truck turned at a Boston corner without seeing the sports car at his side. Only injury: two red faces.



2. OVER AND UNDER: Mechanism is capable of ditching at various angles. Here the fuselage strikes surface on one side and submerges.

Dumbo is lifted, swung out, and dropped into a water tank at the angle of impact normal for the kind of craft for which they are training—on one side if it has a heavy rotor. All have to unfasten their seat belts, escape from the fuselage, and swim to the surface in 10 seconds. Then



3. OUT AND UP: Marines release seat belts, unstrap packs, leave fuselage through door, and swim to the surface—all in under 10 seconds.

Dumbo is raised to prevent accidental drownings. A couple of frogmen are in the pool to help stragglers.

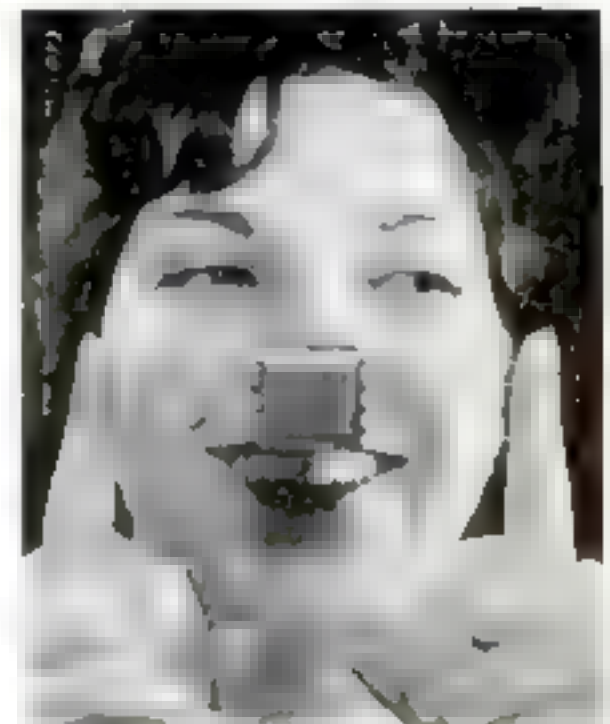
The device was developed for the Navy by Kellett Aircraft Corp., Willow Grove, Pa. It's undergoing tests at the Marine Corps base at Camp Pendleton, Calif.



Putting practice on a pool table

Here's a chance for the golfer who likes to shoot pool and still waste no time from putting practice.

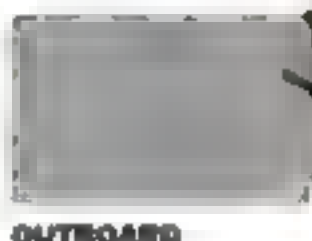
Putter Pool is a new game at hotels and motels in the Southwest and in private back yards. It's played on a 7¼ by 15-foot putting green laid on a six-inch concrete slab padded with resilient carpeting. At the sides and corners are regulation pool pockets, but slightly larger. There are 15 golf-size balls, numbered and colored like pool balls. Putting irons are used instead of cues. Inventor is Tom Tarbox, Phoenix, Ariz.



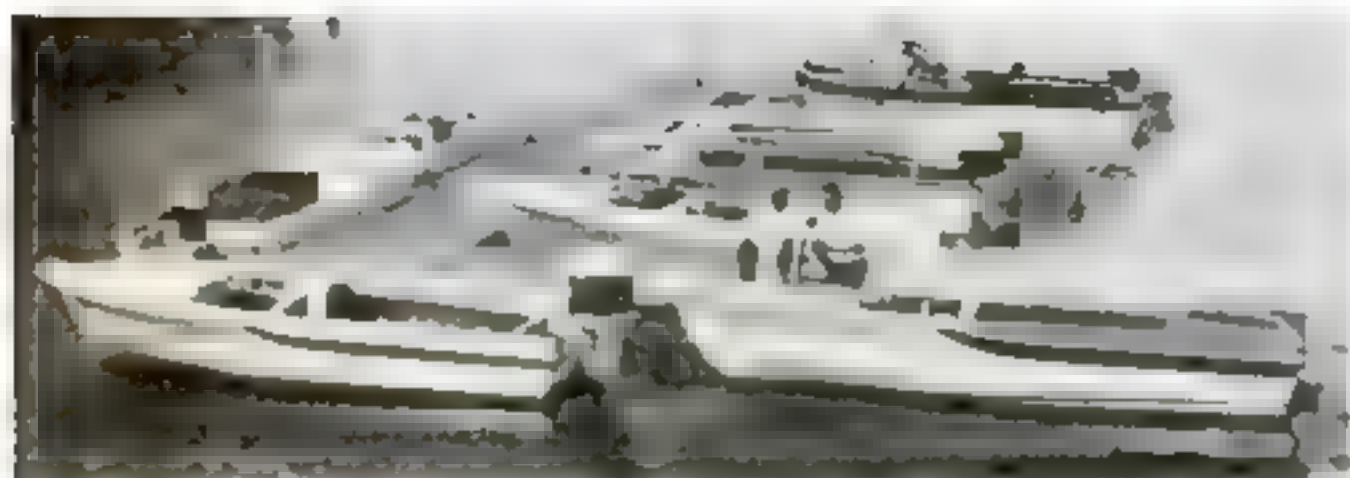
Tiny electric oven

The cat's whiskers displayed here are electrical connections of a miniature oven used in a new airborne computer. The oven was designed by Bulova to keep four small diodes at correct operating temperature.

Can they really combine the good features of both inboards and outboards? Here's an expert's answer



How Good Are the New Inboard-Outboards?



TEST BOATS, five matched pairs of them, were used by author. One of each pair is equipped with an outboard; the other has an inboard-outboard. For most tests, boats were operated side by side. At right, a pair of Glass Magic hulls moves out for fuel and speed tests.

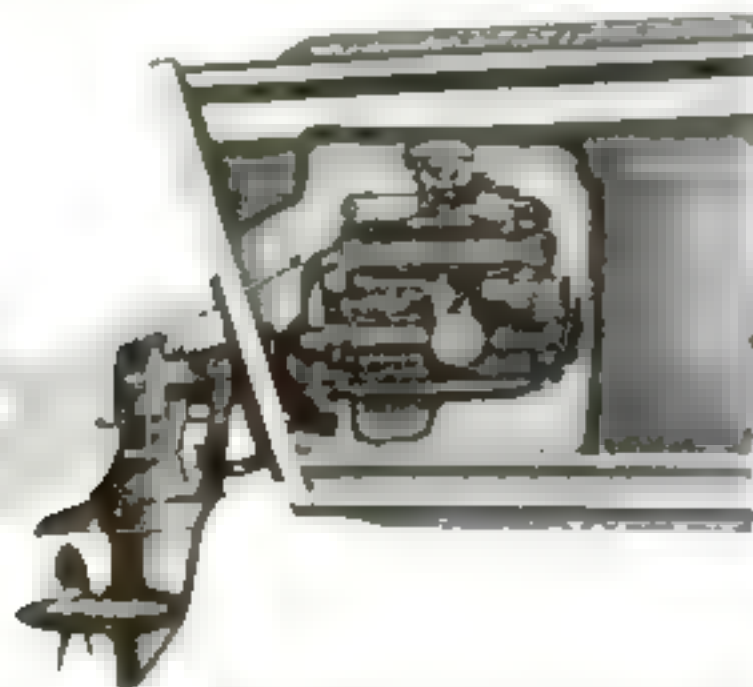
By Hank Wile and Bowman *Nationally Syndicated Boating Columnist*

THE ancient argument of inboard vs. outboard power for small boats is flaring up again. It had just about been laid to rest by the vast improvements in outboards in the past few years.

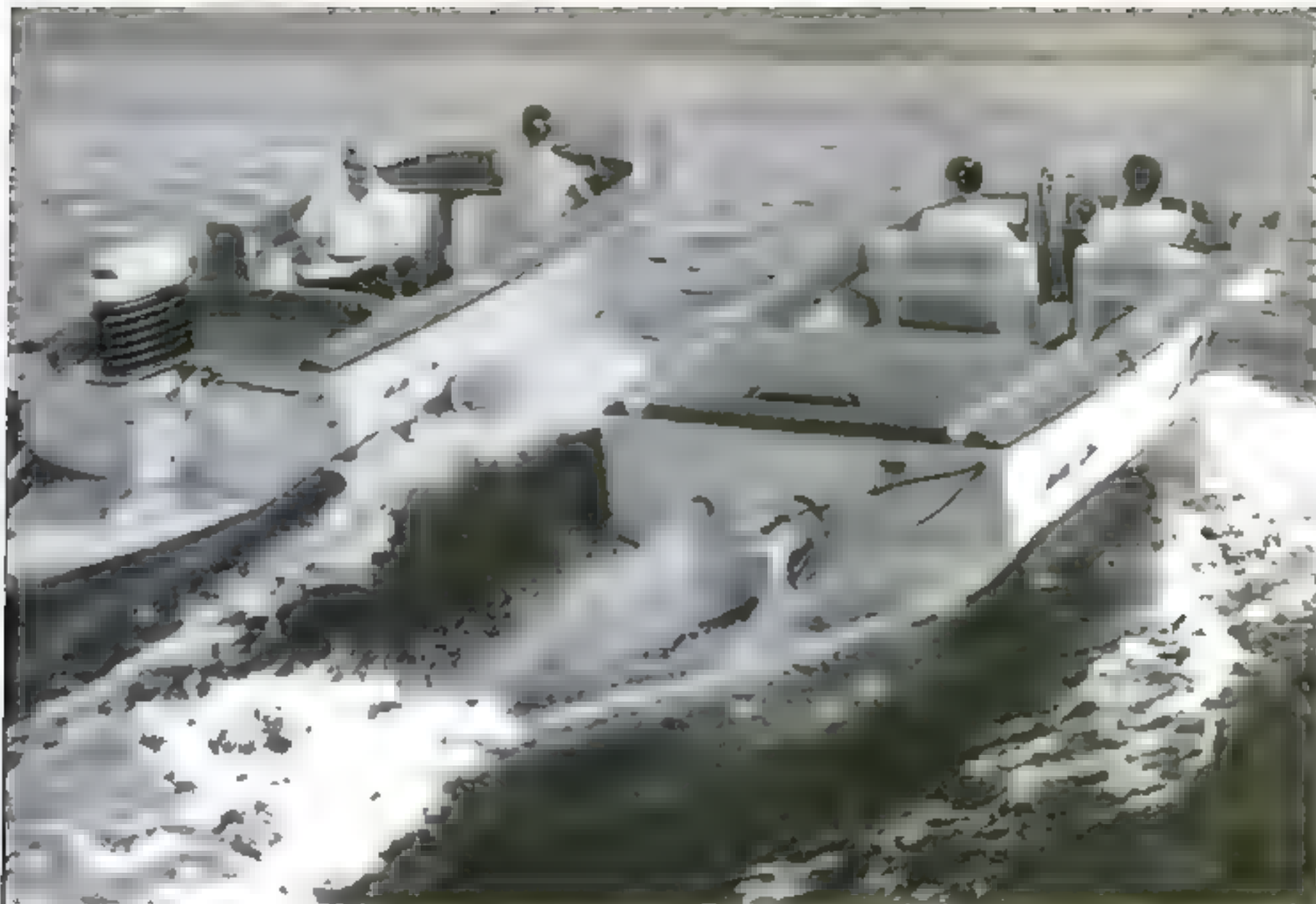
With power and reliability leaving little to be desired, plus electric starting, remote shifting, throttle control, and efficient generators, outboards were winning the battle hands down.

Now a hybrid power plant from Sweden has revived the old controversy. Introduced two years ago, the Volvo-Penta with Aquamatic outboard drive combines an automotive-type inboard engine with an outboard-style drive head. The basic idea is not new, of course: Back in 1949, the Kermath Screwball was offered in six sizes—from 5 to 140 horsepower—but found few customers. Several other combination inboard-outboards have been launched, going back to 1930, but also failed to attract enough buyers. The Volvo-Penta has stirred much more interest than any predecessor—both with boatmen and boatbuilders.

A host of new outdrive propulsion units, applicable to existing power plants, have been announced recently. The Eaton Powernaut and the Volvo-Penta are already in volume production. Others are still on the drawing boards, in proto-



VOLVO AQUAMATIC DRIVE is transom-mounted with vibration-damping rubber supports. Engine power is transmitted from the crankshaft through a Rzeppa universal joint that allows the outdrive unit to pivot or tilt in relation to the drive shaft. The tiller telescopes into a tube when the unit is tilted. The lower drive head is similar to that of an outboard.



type testing, or being produced in limited quantities. Some of these are: Sea Hawk, Sea Power Outdrive, Outboard Marine Stern-Drive, Mercury's MerCruiser, Brennan Motor's Imp, Muncie Gear Works' Flexidrive, U.S. Marine's Float-O-Matic, Brunswick Corp.'s Comboard, the German-built Wido Commodore, and the Turbinautic of Precision Gears and Products.

Why an outdrive? A quick review of the main features of inboard and outboard power will point up the reasons why the outdrive idea is attractive. It's the logical result of efforts to combine the best features of each system.

Inboard power, of course, is unchallenged where high horsepower is needed. Outboard motors now are limited to about 80 hp. In practice, this means that boats from 25-feet up are almost always powered by inboard engines. In boats under 25 feet, the main advantage of inboard installation has been esthetic. The power plants are hidden below deck or in a motor box. Despite attempts by designers, few boatmen view the exposed outboard as a thing of beauty.

Another advantage valued by some



NOISE LEVELS were checked with a sound-level meter. Generally the outboards were quieter. Here are some sample readings, in decibels:

Boat	Outboard	Inboard	Outdrive
18' Adventure	103	117	
Glass Magic	107		112
Hydrodyne	115		128
Magnolia	106		111

CONTINUED

BOAT AND POWER PLANT	FULL THROTTLE			EQUAL SPEEDS			GROSS WEIGHT
	m.p.h.	m.p.g.	g.p.h.	m.p.h.	m.p.g.	g.p.h.	pounds
GLASS MAGIC SURFMASTER							
Merc 800	36	3.9	9.2	32	5.6	5.8	1,282
Eaton Interceptor 100 hp.	32	4.1	8.0	32	4.1	8.0	1,545
18' THOMPSON							
Merc 800	33	3.7	9.0	27	4.7	5.8	1,480
Eaton Interceptor 85 hp.	27	3.7	7.4	27	3.7	7.4	1,935
18' MAGNOLIA							
Merc 800	33	3.4	9.6	29	5.0	5.8	1,472
Eaton Interceptor 85 hp.	29	3.6	8.0	29	3.6	8.0	1,957
17' HYDRODYNE							
Johnson 75	36	4.4	8.1	30	5.5	5.5	—
Volvo-Aquamatic	36	6.6	5.4	30	7.7	3.9	—
Merc 800	38	4.2	9.2	35	5.2	6.7	1,132
Volvo-Aquamatic	35	5.3	6.6	35	5.3	6.6	1,486
17' ADVENTURER SABERFLITE							
Merc 800	38	4.1	9.3	38	4.1	9.3	1,348
Eaton Interceptor 170	39	2.7	14.5	38	2.8	13.8	2,005
21' CORONET CRUISER							
Volvo 80 (inboard)	31	5.4	5.7	27	6.0	4.5	—

Notes: m.p.h., miles per hour; m.p.g., miles per gallon; g.p.h., gallons per hour

owners is the full-height transom, providing security against an engulfing stern wave.

For years, one of the strongest arguments favoring the inboard was the greater reliability and operating ease of the automotive-type engine. Now however, with the enormous improvements

made in outboards in the past decade, these are no longer realistic buying factors. One manufacturer, for example, ran two of his outboards continuously for 50,000 miles without a parts failure. Another used a pair of his engines to drive a 22-foot outboard across the Atlantic.

Operating economy inherent in a four-cycle engine has also been a strong claim made for inboards. But as we shall see later, this has been hard to prove in side-by-side practical tests.

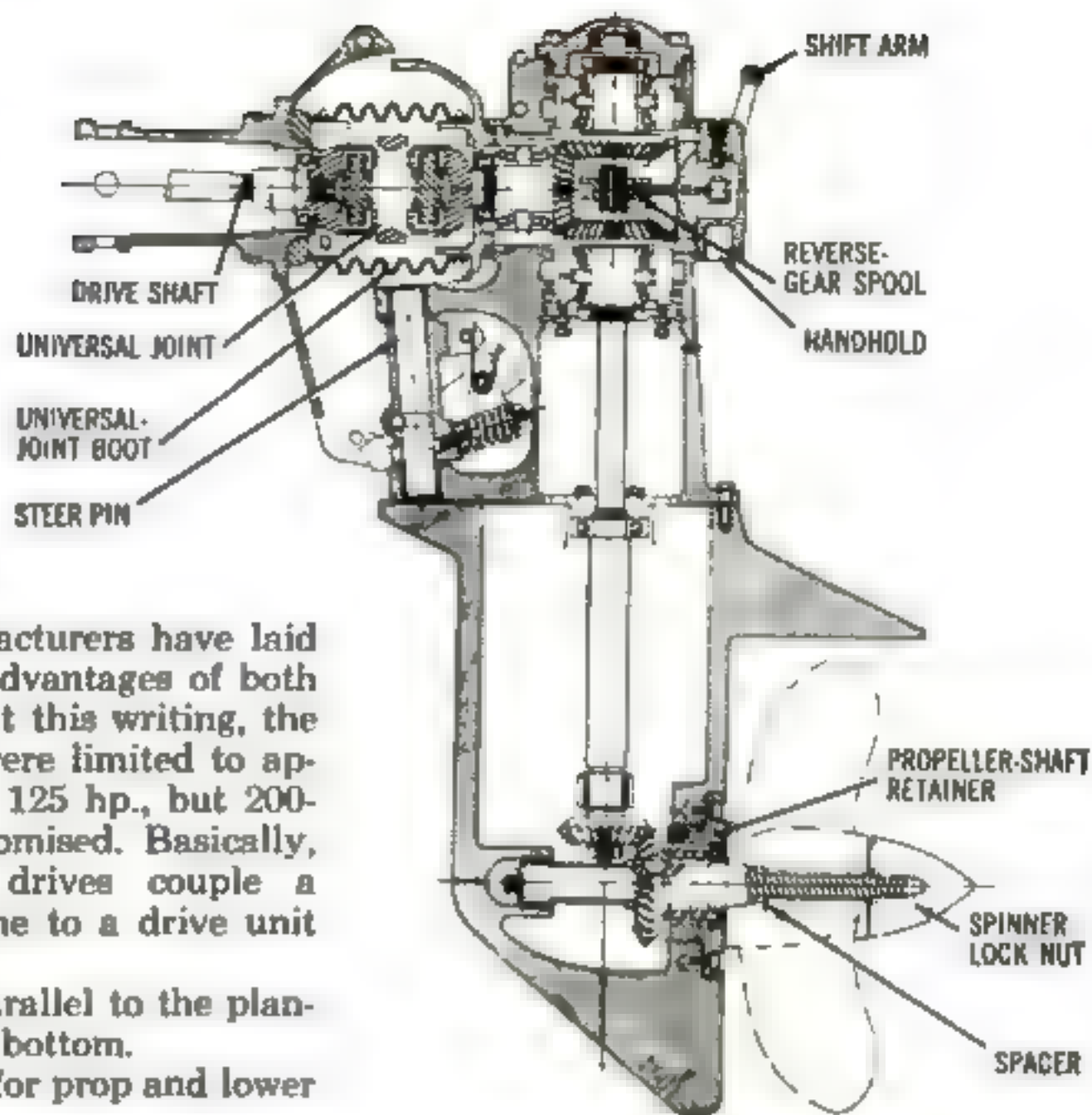
The advantages of an outboard for boats under 25 feet start with the decisive one for most pleasure boatmen—lower first cost. But there are many appealing technical features:

- Easy trailability on standard boat trailers.
- Propeller thrust in line with planing surface of boat.
- Lower weight per horsepower.
- Directional propeller steering for better maneuverability.
- Tilt-up protection for drive unit.
- Easy removal for repair or storage.



FUEL-CONSUMPTION TESTS were made with instruments temporarily installed in both of a matched pair of boats. When possible, checks were made with boats running side by side.

EATON POWERNAUT out-drive, shown here in a cutaway view, is available to fit certain models of Interceptor, Chrysler, and Gray marine engines.



The outdrive manufacturers have laid claim to most of the advantages of both types of propulsion. At this writing, the drive units available were limited to applications of less than 125 hp., but 200-hp. drives have been promised. Basically, all inboard-outboard drives couple a standard inboard engine to a drive unit that incorporates:

- Propeller thrust parallel to the planing surface of the boat bottom.
- Tilt-up protection for prop and lower drive head.
- Pivoting drive head for propeller thrust steering.
- Through-transom installation giving a full-height transom.

Testing the inboard-outboards. There's no doubt that the inboard-outboards have caught the boating public's fancy. A number of boat manufacturers now have them on the market and ready to run. How do they stack up in practical operation against comparable outboards? How well do they measure up to the claims made for them? To get firsthand answers, I made tests on six different outboard installations and six inboard-outboards mounted in identical hulls. The advertised horsepower of the boats compared was very close, with a slight shading in favor of the inboard-outboards. I also included two typical inboards, although there were no identical boats available to me for direct comparison.

The chart shows the raw data I collected on the test runs. These are the result of objective measurements—the reader can draw his own conclusions. My summarized observations are subjective and naturally open to dispute.

From these tests, it seems to me that

[Continued on page 206]



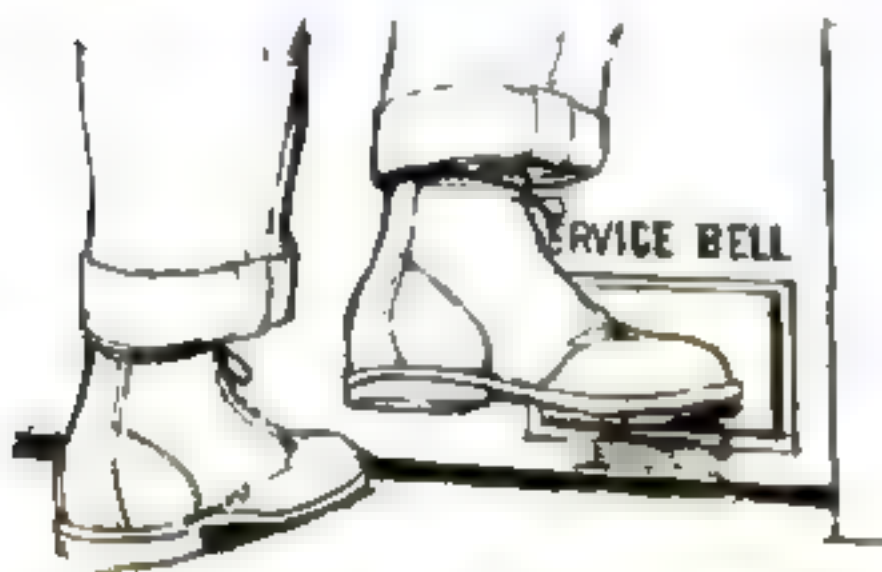
FULL-PIVOTING FEATURE of the Eaton Powernaut allows lower drive unit to swing up through 180 degrees. It takes plenty of muscle to swing it, but this feature could prove handy for a deep-water prop change or inspection.

"I'd like to see them make..."



MEASURING DECALS for fishermen. With a ruler on your tackle box or the gunwale of your boat,

you'd never have to guess about the length of a fish.—Ken Mueller, Eugene, Ore.



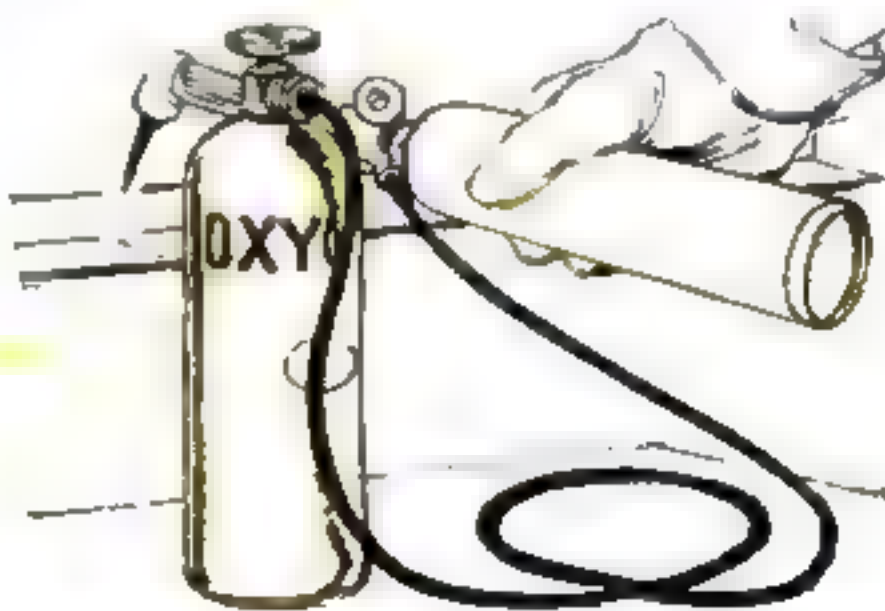
A DOORBELL PLATE that could be installed at the bottom of a service door. Tapping the plate with the toe of your shoe would ring the bell for you.—Paul Patete, Canton, Ohio.



A MUD FLAP reaching from one rear wheel to the other on station wagons to eliminate the dust and dirt that collects on the rear window.—James St. George, Shelburne, Vt.



SQUARED-OFF MOTOR-OIL CANS so you could salvage them for your shop or garage. With one side cut away, they'd make fine drawers for small parts.—N. D. Stowell, Wichita, Kan.



BOTTLES OF OXYGEN you could team up with a propane torch for metal cutting or for welding jobs. Both hobbyists and home owners would benefit.—Joseph E. Blaze, Alliance, Ohio.

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.



AERODYNAMIC DESIGN of 8½-foot body reduces side sway in high wind; 5-foot height provides room for dressing inside. The trailer weighs 500 pounds—light enough for maneuvering unhitched in tight spots.

A complete camping trailer

Even after a muddy or dusty trip, this trailer is ready to go again—spick and span—with almost no trouble. Its fiber-glass body can be cleaned inside and out with a damp cloth. The interior has no dust-catching corners.

The Towhee camper is small and light enough to meet highway restrictions without brakes, yet large enough for ample headroom while dressing—or for a card game to while away time on rainy days. It sleeps two adults and a child.

Barton Industries, Long Beach, Calif., manufactures the trailer in a choice of bonded pastel shades, sells it, including mattress, butane cookstove, and 6- or 12-volt wiring system, for \$795.



TOP-HINGED DOORS swing out like wings at turn of the recessed handles. Interior holds a 6¼-foot-long vinyl-covered mattress over 3 feet wide. Luggage compartment is in rear, behind sliding hardboard doors.



CHOPPING BOARD in kitchenette conceals 50-pound ice chest. Three-burner stove lifts up for access to fuel and additional storage space. Sink is fed from 12-gallon water tank, baffled to prevent sloshing while on road.



Chair lift for zoo visitors

It was a hard climb to animal quarters atop a steep hill at the Dudley Zoo in Birmingham, England—until the authorities became thoughtful enough to install a ski-type chair lift. Now visitors not only ease leg muscles but are treated to a good view as well.



White House automat

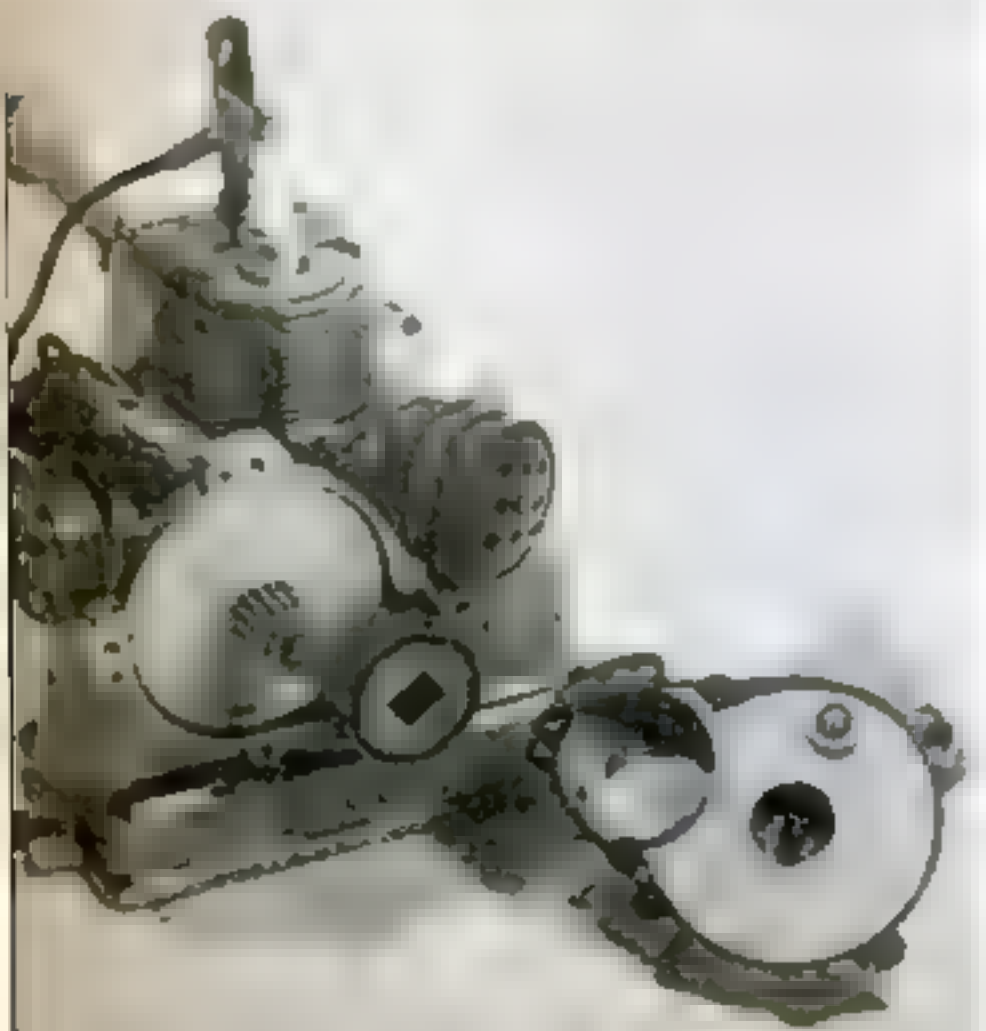
A coin-operated snack bar has made its appearance in the White House. Vending machines offering hot soup, sandwiches, beverages, ice cream, and cigarettes have been set up for the convenience of about 75 clerks, stenographers, and guards on the staff of President Kennedy.

3/4 Horsepower from a 3¼-Pound



DIAPHRAGM-TYPE CARBURETOR lets Ohlsson & Rice engine run in any attitude, even inverted. Sensitive air-vane governor cuts in and out with eye-blinking quickness. Recoil starter and choke control provide easy starting.

OPTIONAL GEARBOX reduces the little engine's 6,300 r.p.m. to a high-torque 900-r.p.m. output. A centrifugal clutch within the gearbox engages automatically when the engine is opened up, and drops out when the engine is idled.



This tiny new two-cycle power plant promises a whole new family of self-powered tools

By V. Lee Oertle

PULL on the starter cord of the prime mover pictured (almost full size) at the right. When it fires, flick open the choke and let it wind up to its full governed speed of 6,300 revs. Then pick it up—watch out for that stinger on the plug terminal!—and heft it. The hot, noisy, smoky, throbbing little hunk of metal in your hand, capable of putting out three-fourths of a horsepower for hours at a time, actually weighs less than a quart bottle of beer.

The horsepower gap. For years there's been a missing band in the spectrum of small engines. At the bottom there have been model-plane engines—vigorous little wasps that weigh only ounces but are difficult to harness to everyday duties. At the top are families of one-lungers that run lawn mowers, chain saws, and rowboats, but that weigh in at about 15 pounds and up, mostly up.

Between them there's been almost nothing, until the new "Ultra Compact" engine at right came along. It's small in size as well as weight: a six-inch cube will enclose it. No temperamental toy, it starts willingly and runs with the docile manners of its cast-iron big brothers.

Power-tool revolution? Some of the little engine's possibilities are eye-opening. It is capable of doing the same work as a ½-hp. electric motor, and of course weighs far less. While its smoky blue exhaust means that it wants open-air applications, it needs no trailing power cord, and is ideal for places where there's no place to plug into anyway. So new and different that many of its ultimate applications have not yet been invented, the engine has already been put to work driving portable saws, generators, pumps, compressors, bicycles, and garden tools.

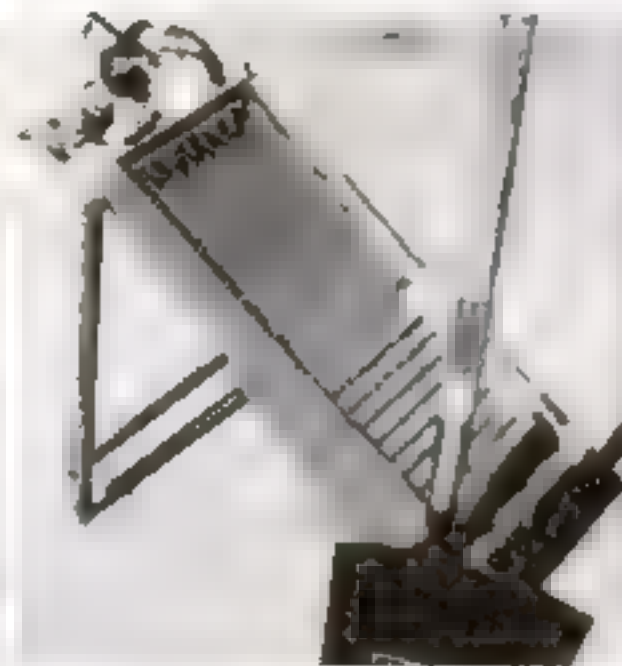
Engine



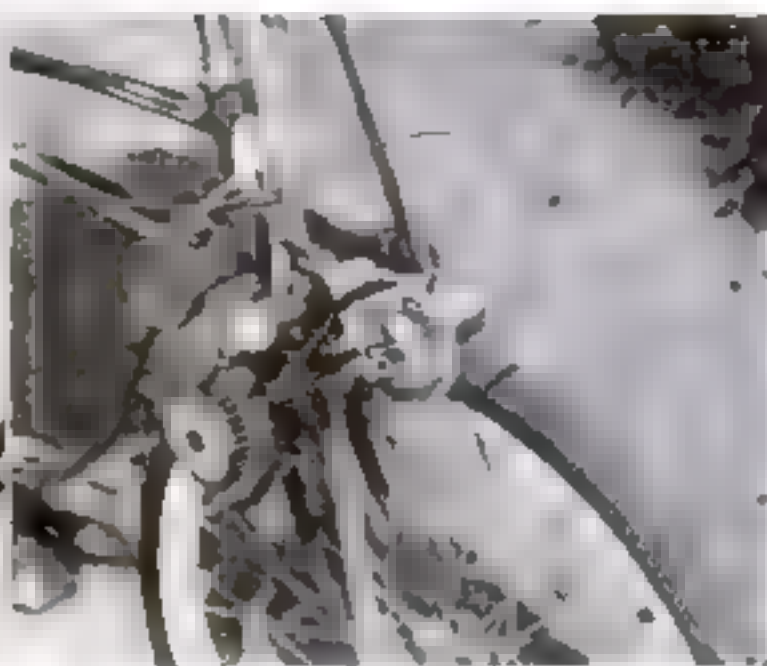
Already at work on a variety of jobs, the Ultra



SENSIBLE SPEEDS are assured in children's karts with the use of the new engine (12-14 m.p.h. top speed is estimated). It could start a new kart class.



DRY CONCENTRATOR separates gold from dirt. Engine-operated bellows under rippled lower end blows up sand and leaves the heavier gold particles.



TEN-MINUTE motorbike conversion: Engine mounted on handlebar powers a drive wheel that turns the tire. Savidge Co., Venice, Calif., makes the kit.



TINY AIRCRAFT TRACTOR with O & R engine is attached to landing gear. Pressure on the handle forces the drive wheel against tire to move the plane

But offbeat applications have already turned up in the first weeks that the engine has been on the market. One is a "power parker" for airplanes. Another is a commercial nutcracker. A third is a gold-panning machine. At this writing, one man is hard at work using it to power an air-conditioned suit—he figures the rig would be fine for sweltering operators of big earth-moving machines.

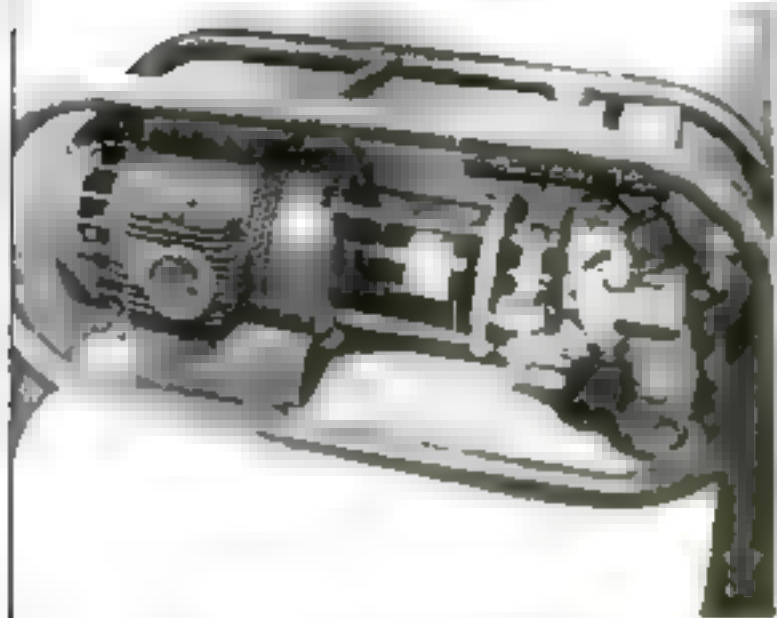
The man behind it. Harry T. Rice, its designer and developer, is a lean, balding man of 55, endowed with extraordinary energy. His typical day at the office starts

at sunrise and all too frequently ends at midnight. It is more often spent at a shop machine than at a desk.

He was evidently born with an affinity for engines and an incurable zest for tinkering and experimenting. In his teens, in Southern California, he used to build and race his own motorcycle engines.

After high school, he decided that he needed to know more about his favorite subject than he could learn on the run. He couldn't afford to go to college, so he chose to improve his knowledge by I.C.S. correspondence courses. He first

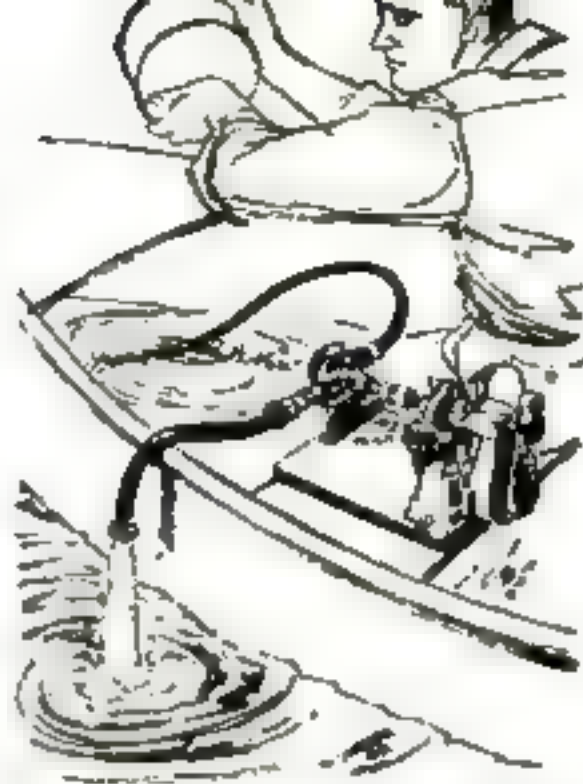
Compact should find many new uses



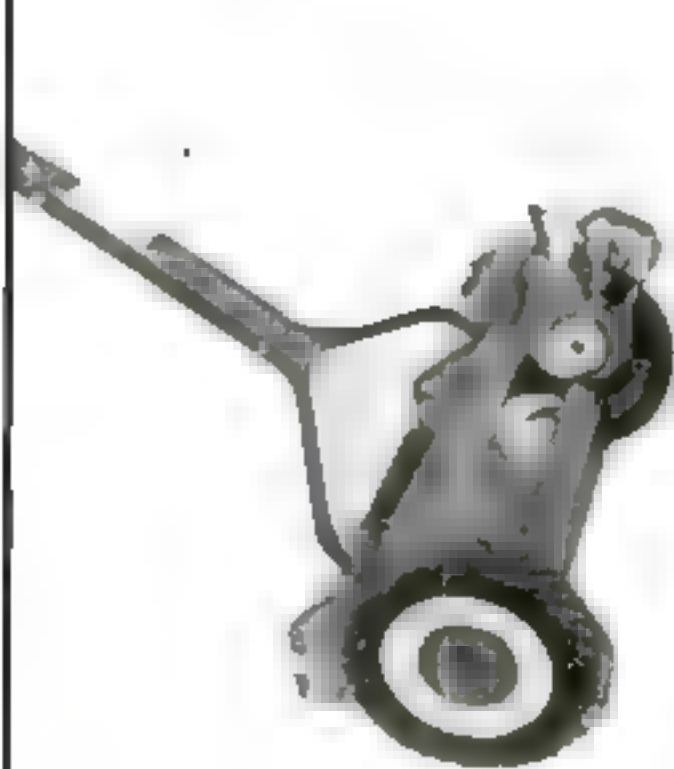
PORTABLE AIR COMPRESSOR for skin diving delivers $1\frac{1}{2}$ c.f.m. of oil-free air at 50 p.s.i. It's manufactured by Westec-Sweetland, Los Angeles.



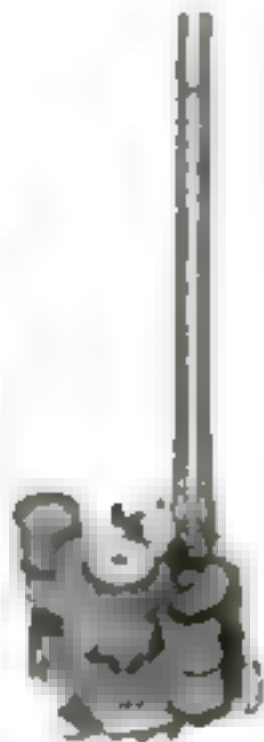
PROTOTYPE of hand-held power saw holds promise of many more light-duty gas-powered tools. Underdeveloped areas would benefit most from these.



BILGE PUMP run by the O & R compact would make a handy safety device for the small-boat owner. The engine could even power a small canoe.



LIGHT POWER MOWERS, lawn-edger trimmers, hedge clippers, small tillers, tree pruners, sprayers, power wheelbarrows, and many other garden and farm tools are likely candidates for the new O & R light, compact engine.



"SMOKE JUMPERS," parachute crews that fight forest fires, could use portable engine-operated pump and back pack with water tank.

studied mechanical-engineering drafting, design, and math; then topped off his education with courses in aircraft-engineering design and development.

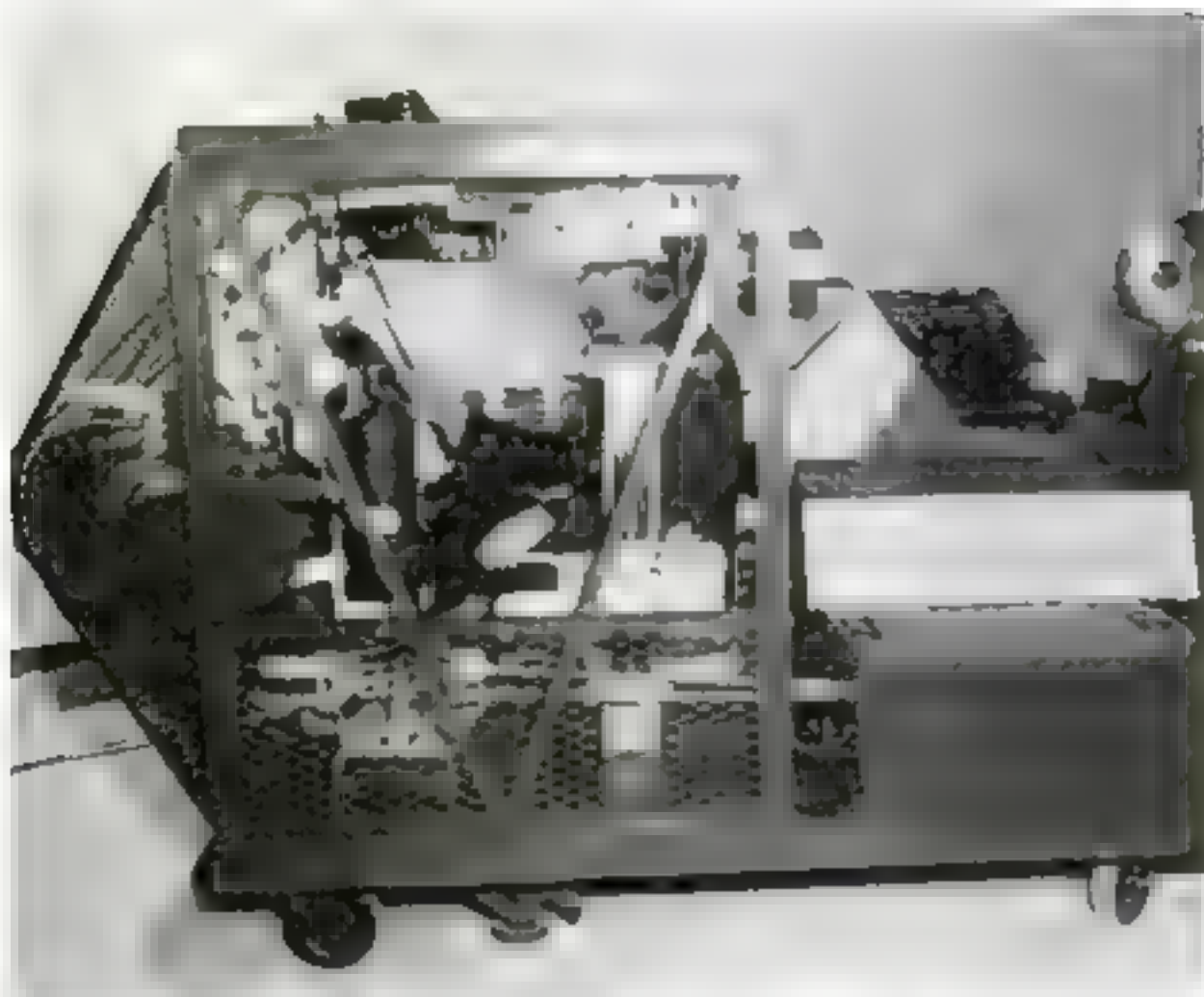
A Quiet Birdman. His interest in aviation led him to learn to fly. This was in 1925, and in the cockpit of one of the old, beloved "Jennies." The experience earned him membership in the society of Quiet Birdmen, a group of old-time aviators who taught themselves to be pilots in that forgiving craft.

Then, with dynamic self-confidence, Rice decided to start a business. He hit

upon the happy scheme of combining two enthusiasms—aviation and engines—and making a livelihood from them. He began to design and build tiny engines for model airplanes.

His factory was the family garage in the little town of San Gabriel. There, sometimes all alone, occasionally with as many as three or four employees, he turned out a product that caught the public fancy. The response was so lively it pushed him out of the garage and into a small manufacturing plant in Los An-

[Continued on page 208]



Trainer for tank drivers

Rough going while driving an M48A2 medium tank is simulated in the trainer at left.

Switches, gauges, instruments, and gears are activated by an electromechanical system that includes analog computers and audio equipment. An instructor at a console can throw in emergency situations at any time. Sound effects are taped.

The new trainer was developed for the Army at the Naval Training Device Center, Port Washington, N. Y.



Like a taffy puller

Blades in the machine above thoroughly mix the ingredients of the solid propellant that fires the Navy's submarine-launched Polaris missile. After being mixed to proper consistency, the fuel is dried, pressed into a motor case, baked at 140 degrees, and allowed to cool slowly to room temperature. The mixer is installed at the Indian Head Naval Propellant Plant in Maryland.



Optical radar for space

The sharp red beam from a synthetic ruby makes a more precise kind of radar for spaceships. Like ordinary radar, Hughes Aircraft's Colidar locates objects by timing an echo. But it uses visible light instead of radio waves, gaining accuracy and range because the light beam it sends out is narrow and pure in color. This "coherent" light is generated by a ruby crystal that is tickled electronically in a laser (light amplification by stimulated emission of radiation) seen under man's forefinger. Telescope below it is the light radar's receiver



In this purported photo, Scotland's famed tourist attraction rears its head for a look around.

How zoologists are probing remote corners of the world for strange unknown animals

From the Loch Ness Monster to the Giant Squid

By Gardner Soule

THE Loch Ness monster, the mysterious animal that people report seeing in a lake in the highlands of Scotland, is at last being taken seriously. Next month the universities of Oxford and Cambridge will send an expedition of 30 zoologists to Loch Ness—a beautiful 22½-mile-long lake that reaches a depth of 754 feet. Equipped with boats, binoculars, telephoto cameras, and sounding gear, the scientists are prepared to find out what Scotland's "Great Beastie" is, even if it takes them all summer.

If the monster turns out to be more than a hallucination, it won't be the first time that a previously unidentified creature has achieved scientific respectability.

Many once-unknown animals have turned up in the last 150 years. They include the king cheetah (a great cat discovered in Rhodesia), Grevy's zebra, Przewalski's horse, the biggest rhinoceros, the giant forest hog, the biggest lizard (the Komodo dragon), the gorilla, one of the world's largest rodents (the pacarana, of Peru), the pygmy hippopotamus, the Alaskan Kodiak bear (at 1,600 pounds the world's largest meat eater), the hamster, the snow leopard.

Besides the Loch Ness monster, there are a number of animals that have been reported by reliable eyewitnesses—explorers and scientists—but never captured. Some of the legendary animals that may yet turn out to be true are shown on the next two pages.

CONTINUED

These are some of the weird creatures reported by



The Mongrel That Wasn't

In Argentina in 1926 Lorenz Hagenbeck bought the skin of a large wolf with a mane, an Andean wolf. Because the canine world (wolves, dogs) has the reputation of producing offspring whose ancestry can't be traced, zoologists yawned. But in 1947 Hagenbeck told Dr. Ingo Krumbiegel that he'd seen three other such skins. This made the creature more than a one-time canine accident. In 1949 Krumbiegel gave it a name: Hagenbeck's mountain dog. It is still uncaptured.



Nandi Bear: The Great Scalper

Sixty years of mystery began around the turn of the century in Africa, which has no known bears. There Geoffrey Williams saw an animal "sitting on its haunches . . . its attitude that of a bear at the zoo asking for buns." After he missed a shot, it looked at him. "The head was exactly like that of a bear." By 1961, natives and many Europeans claimed to have seen a bear in Africa. Besides, something unknown kills men there by clawing their heads as a bear might.



Kangaroo Killer

Tales of a tiger cat in Australia have been so many and so detailed that the animal is already included in Australian zoology textbooks, even though it's never been caught. Reported Ian Idriess of a tiger cat's attack on a kangaroo: "I saw a full-grown kangaroo backed up against a tree . . . A streak of black and gray shot toward the 'roo's throat, then seemed to twist in the air, and the kangaroo slid to earth with its entrails literally torn out of its body."



A Fairy Tale?

Two Europeans—Cuthbert Burgoyne and Bill Hichens—on separate occasions saw men tinier than pygmies among herds of baboons. They were "two small, brown, furry creatures about four feet high," said lion-hunter Hichens. In 1946 and 1947, similar little men were observed on the Ivory Coast. Bones of tiny men have been dug up in Switzerland. Africa's little men and the Swiss bones suggest that elves and gnomes are not, perhaps, just phantom figures in fairy tales.

alleged eyewitnesses in various parts of the globe



Leaping Lizard

Although most unknown animals are in wildernesses, some are near crowded cities. In the Alps, people report they are frequently hissed at by Europe's best-known unknown animal, the tatzelwurm, which hundreds claim to have seen but no one has caught. In the 1930s, a newspaper survey produced no fewer than 60 who claimed they'd seen a tatzelwurm. It's described as a fat, three-foot-long worm, with short legs that barely touch ground, like a skink's.



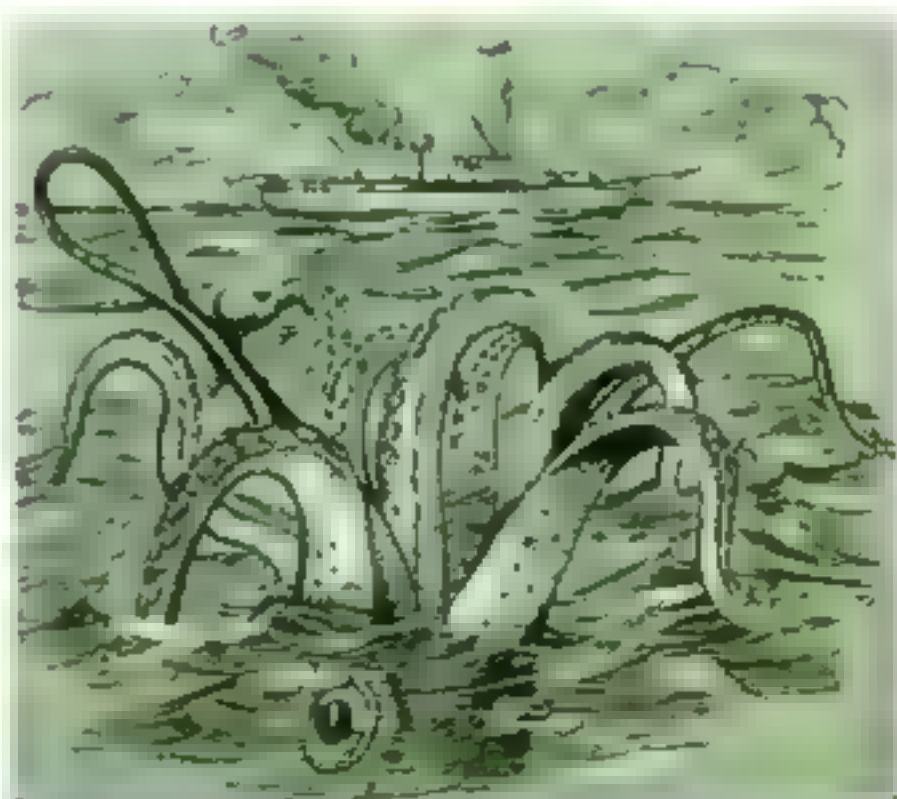
Mngwa: Great Gray Ghost

West African natives tell of a gray, pony-size lion (pronounced moong-wah) that has, they say, clawed men to death—they were found clutching gray catlike fur. A rash of such killings occurred in the 1920s and 1930s, when tracks like a giant leopard's were found. In Kenya today, some tribes still stoutly insist on the existence of a ferocious gray-necked lion. White hunters are skeptical. They say the Mngwa is just an albino lion—rare but not unknown.



American Anthropoid

Late in the 1950s, howls from the South American jungle (reported by prospectors) and 21-inch footprints (found along rivers) revived reports of a large ape in South America, where none is known. A few years ago, cattle were found dead in Peru, their tongues torn out—as though grasped by a hand. As long ago as 1917, a geologist named Francois de Loys photographed a monkey with a stature exceeding five feet in South America. But its species was never identified.



Giant Squid

One day in 1895, near the Azores, Prince Albert of Monaco was collecting oceanographic data. A whaling crew chased a sperm whale under his yacht. The whale surfaced, died vomiting up its last meal: undigested parts of a giant squid—enough to prove there really was a monster with 10 tentacles, some perhaps 50 feet long. To this day the squid has not been caught alive, possibly because, like the Loch Ness monster, it may dwell far below the surface.

Firehouse-in-the-round

A new ultramodern glass and concrete firehouse looks like a park pavilion—intentionally. It was designed that way to fit into the landscaping of a small, triangular park in North Berkeley, Calif., to spare as many of its pines and red woods as possible, and to preserve its natural beauty.

The structure is a series of spaced concrete columns around the perimeter of a clear, glass wall. A peak on top of its circular roof is also glass. Semicircular additions provide office space, sleeping and living quarters, and storage.

The building houses a pumper—the department's newest piece of equipment—and the chief's car.

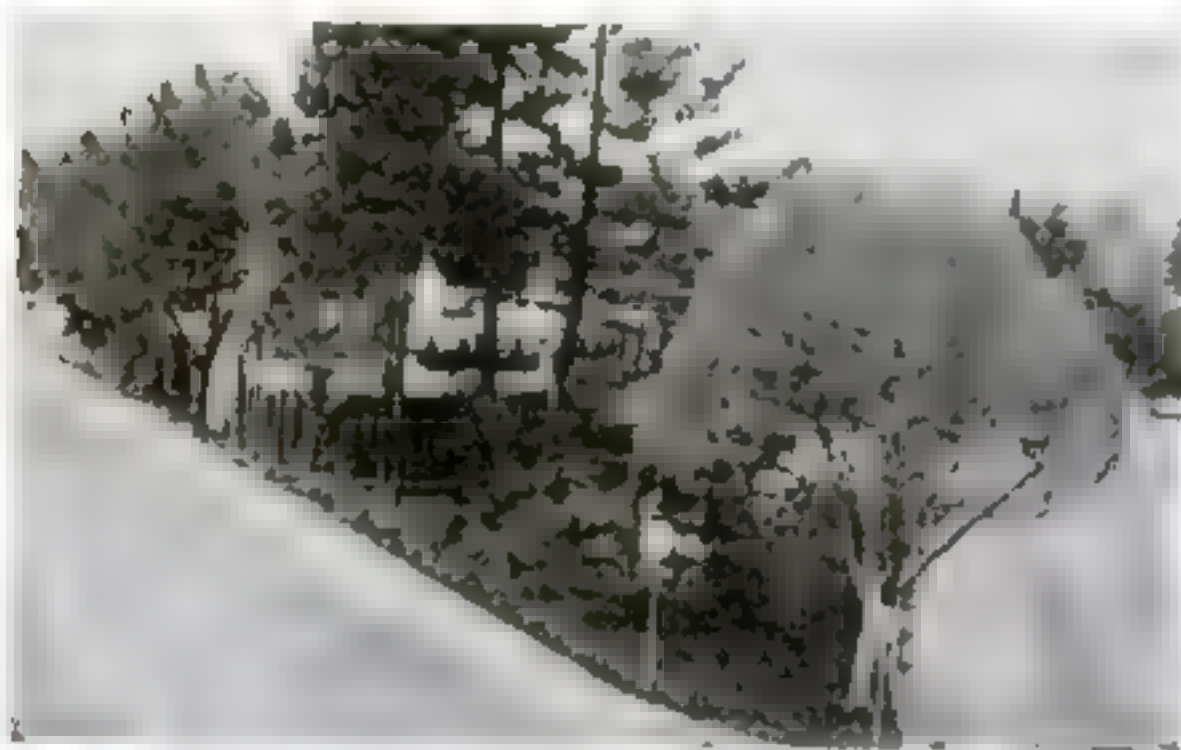


GLASS WALL behind engine separates it from a semicircular addition that houses a comfortable lounge, kitchen, and wedge-shaped bedrooms.

LIKE A PAVILION, firehouse enhances beauty of the small park below. Living quarters are in foreground, storage at left, office at right.

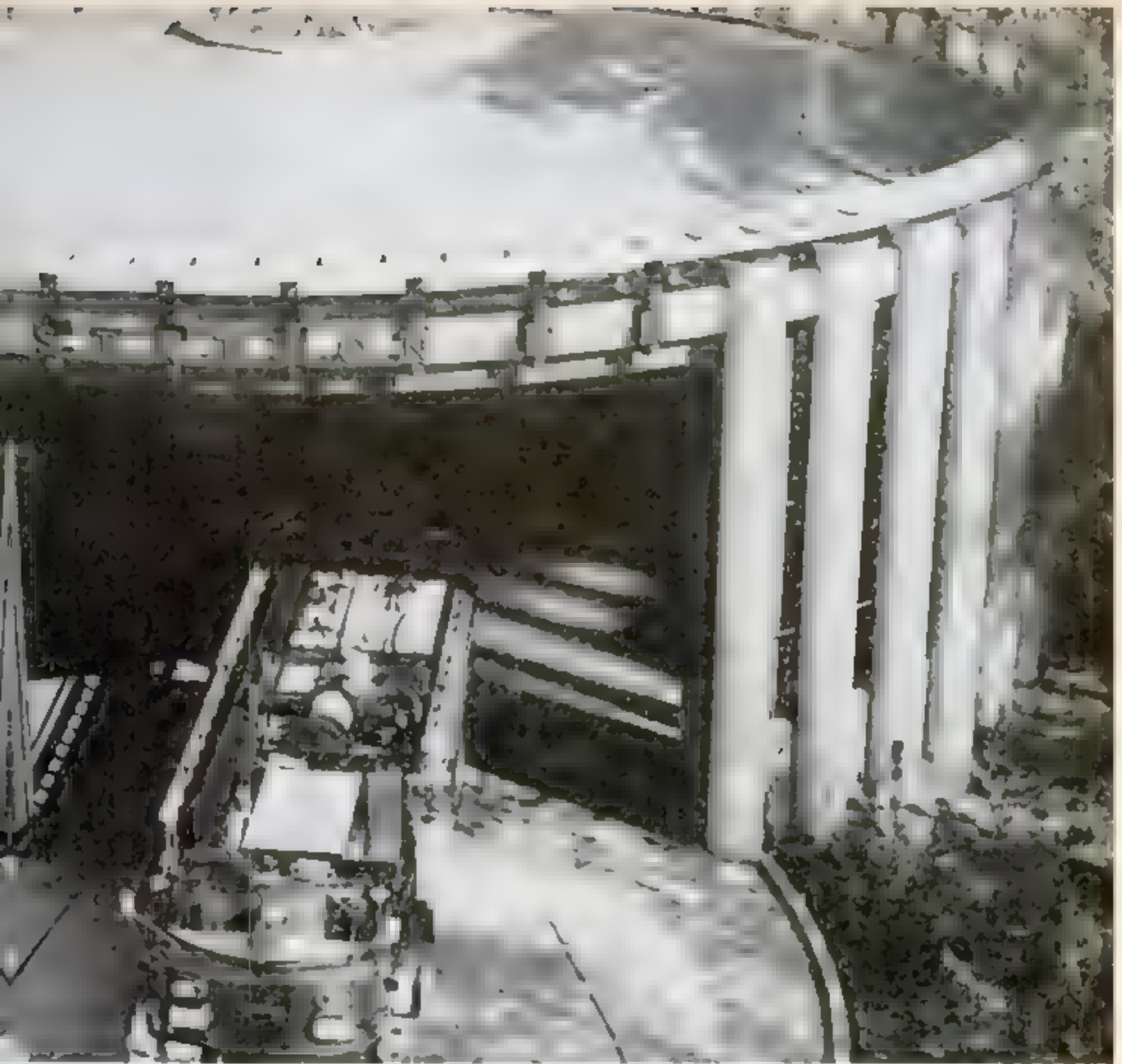


Park fire station is a series of



Safe medicine bottle

The next time you have a prescription filled at your drugstore, the bottle your medicine is put in—either liquid or tablets—may have a safety cap like the one the child at left is vainly trying to unscrew. It's a double plastic cap, the inner part being fitted with threads that can't engage unless you press down on the outer while turning it—a coordination of two distinct motions that psychologists find children under six usually can't master. The cap is made by Brockway Glass Co., Brockway, Pa., for pharmaceutical houses and druggists.



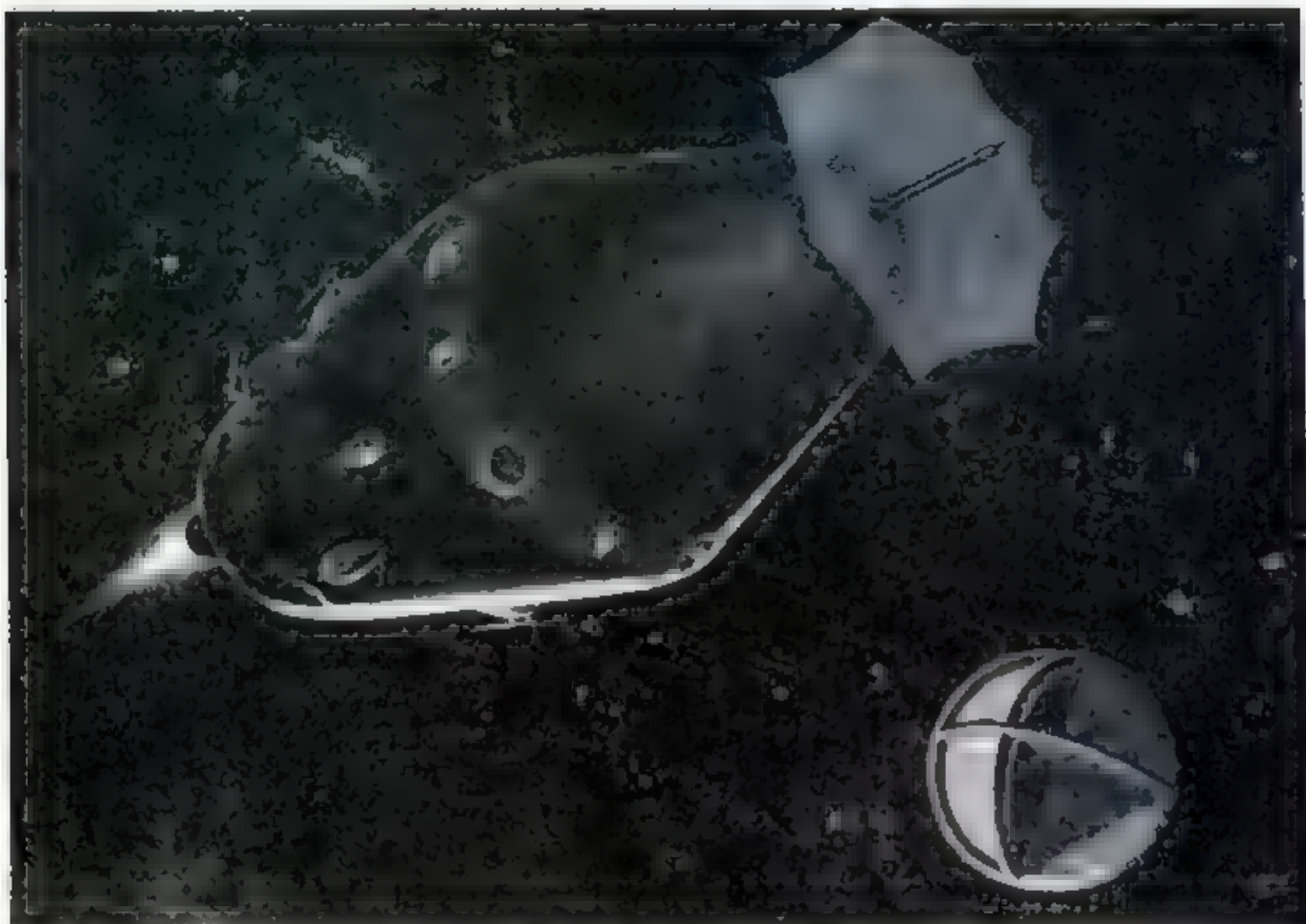
concrete columns surrounding circular wall of clear glass. Office is at left of main doorway.

Grease monkey travels on wheels

Repairs, on-site grease jobs, and routine maintenance are provided for London motorists who don't want to drive their Jaguars and Rovers to the garage.

Henlys, a big auto agency, runs a fleet of Land Rovers carrying pressure-lubrication equipment, special tools, and a stock of spare parts to service a car at home or the office.

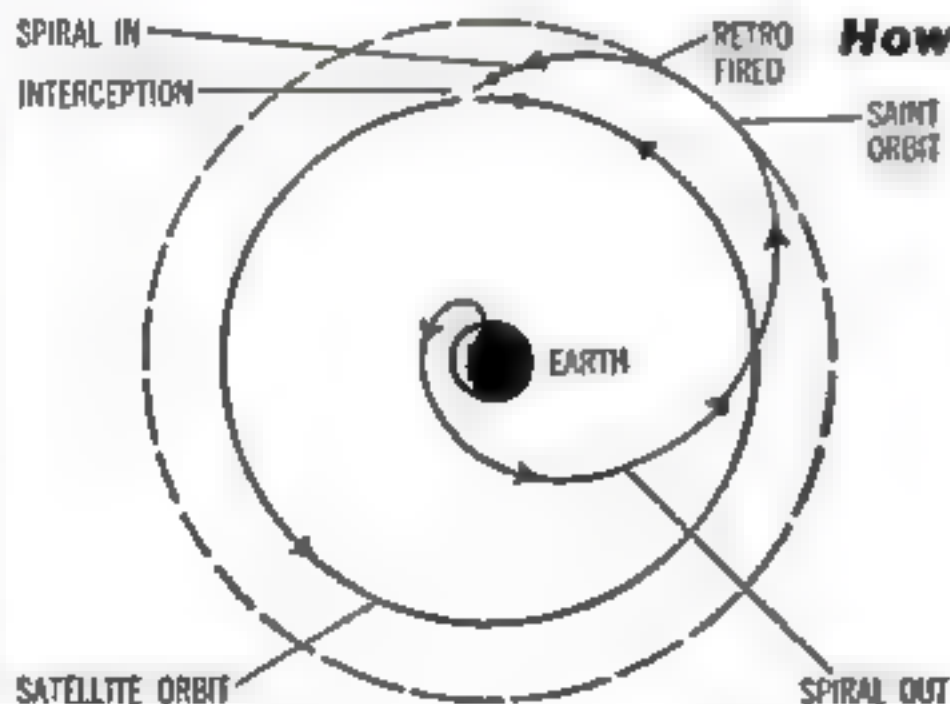




"SAINT" ANTI-SATELLITE inspects a satellite, as in coming trials. In likely design pictured, retro-rocket and umbrellalike radar antenna

propel and guide Saint to within 100-foot range. As jets slowly rotate it, TV lenses and other sensors, amidships, scan the satellite in turn.

U.S. Plans First Warship in Space



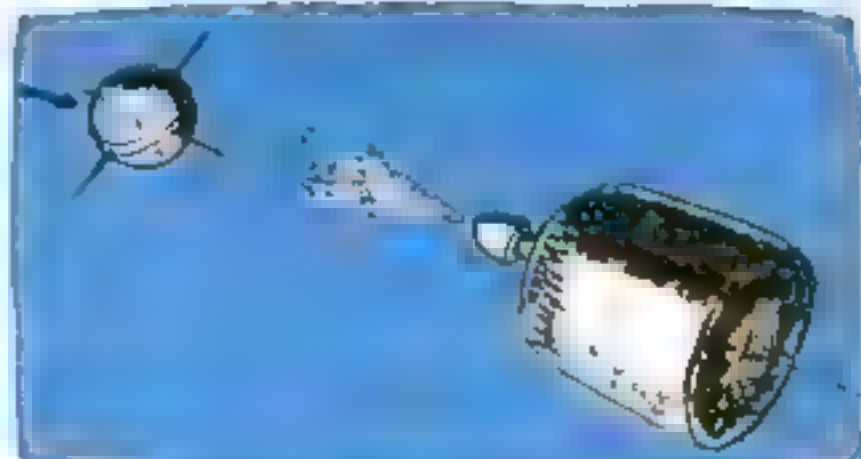
How anti-satellite gets to target

Rendezvous maneuver launches Saint into orbit above that of satellite target, and it briefly becomes a satellite itself. At point ahead of target, it separates from Agena second-stage rocket (which has turned over to aim it backward) and checks its speed with retro-rocket. This makes it spiral down toward target. Homing controls regulate rocket engine and auxiliary jets for gentle approach to viewing range. Maneuver is simplest when Saint is launched into same plane as orbit of satellite—as in diagram and first trials—but alternate, dog-leg courses are feasible, experts say.

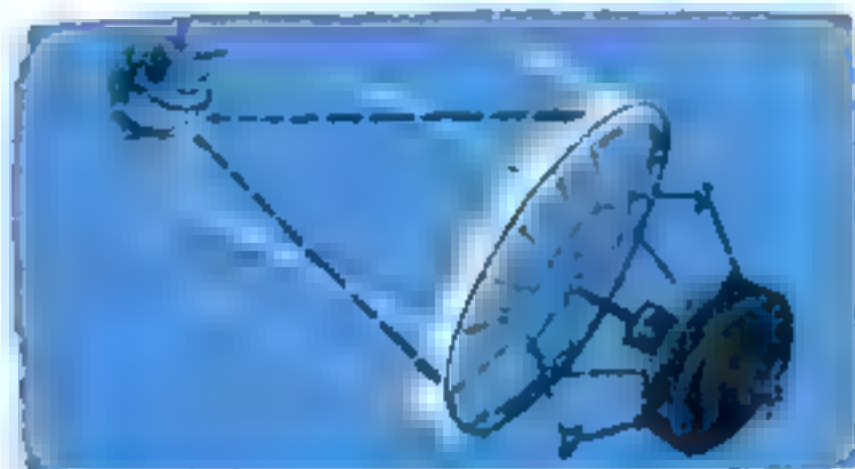
For a kill, anti-satellites may wield weapons like these



PAINT-SPRAYING GUN could blind a military photo satellite by coating its lenses with opaque paint—a possible cold-war tactic.



HURLING SAND or shot in path of satellite would simulate damage by meteor shower, and could serve for clandestine sabotage.



SOLAR MIRROR would concentrate sun's rays to "cook" a satellite, putting its heat-sensitive electronic gear out of commission.



NUCLEAR WARHEAD could vaporize an H-bomb satellite at close range. At greater distance, it could disarm bomb by "neutron heating."

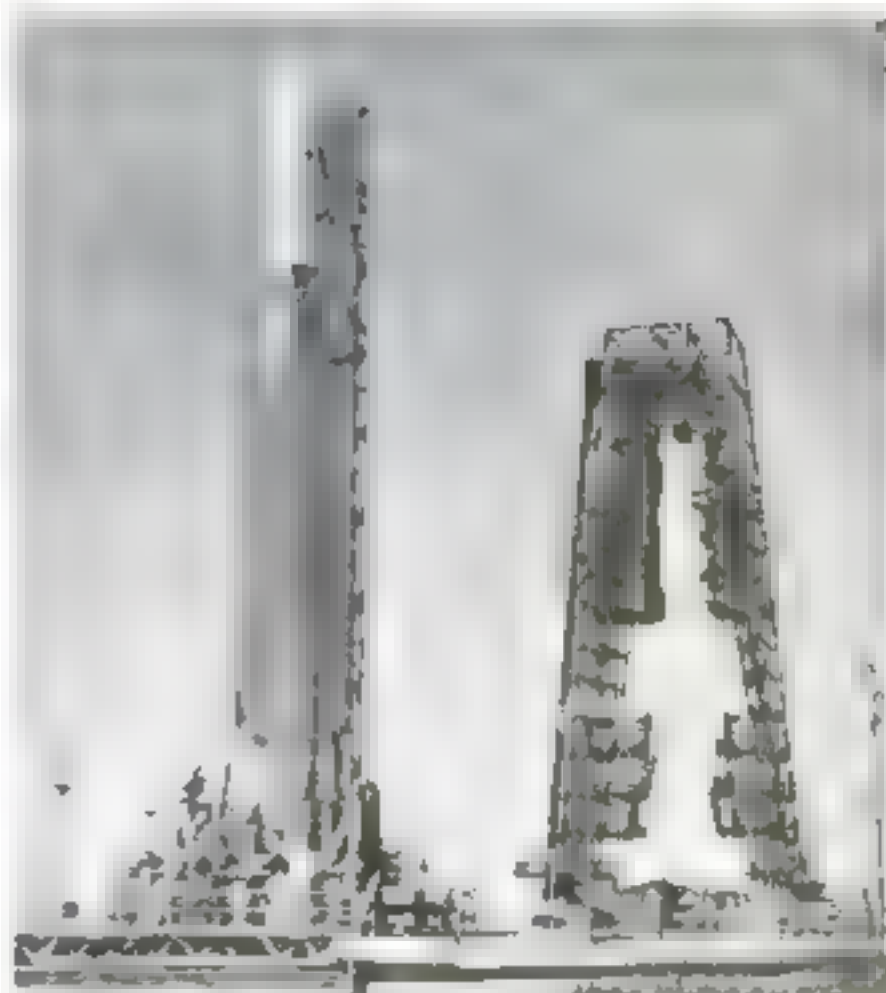
"Saint" anti-satellite will try out design for a rocket craft that would intercept and knock out a foe's orbiting H-bombers

By Alden P. Armagnac

A MILITARY anti-satellite is in the making for the U. S. The Air Force reveals it is developing a crewless rocket vehicle to intercept an unidentified earth satellite, determine whether it is peaceful or hostile, and report the findings to our armed forces.

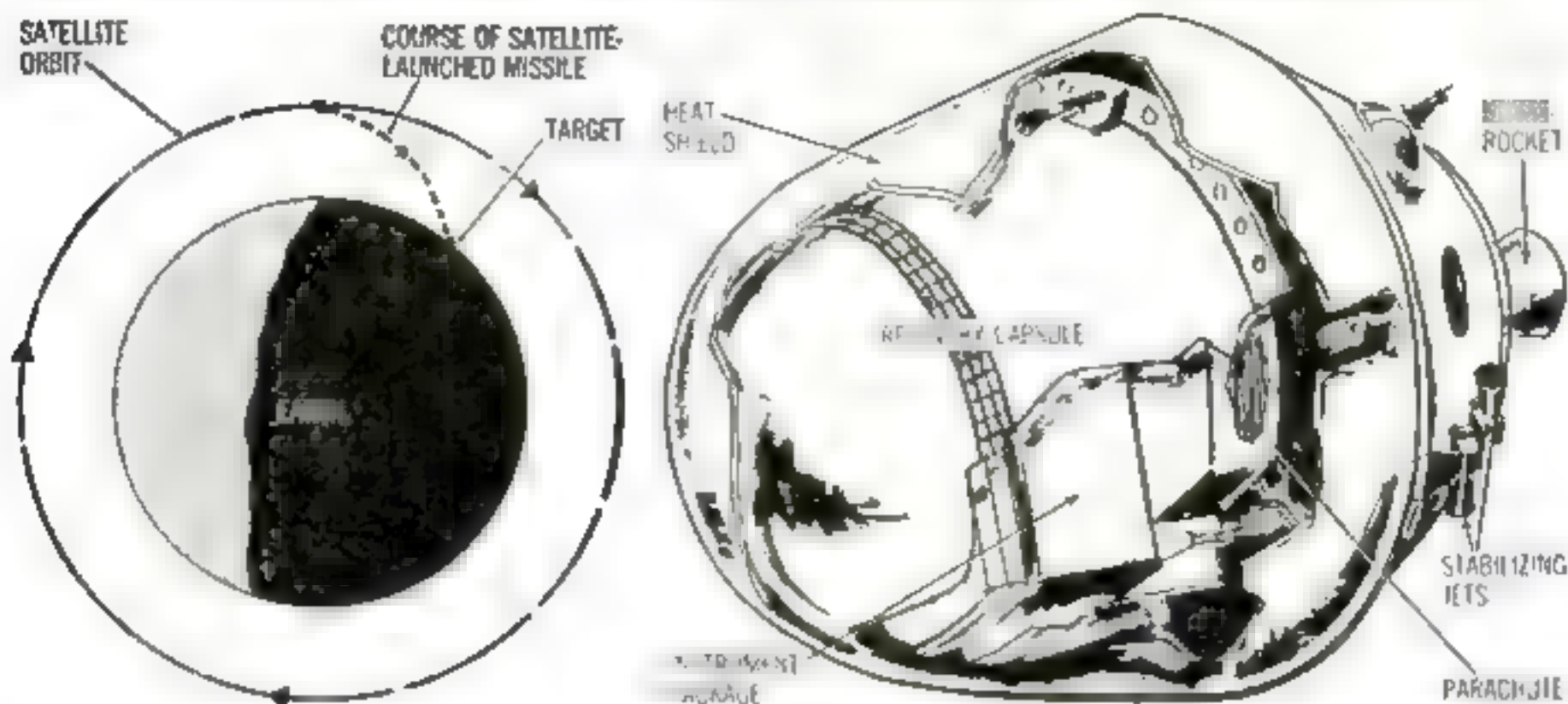
Spurred by the newly demonstrated possibilities of satellites as weapons, the high-priority \$60,000,000, three-year defense program is called Project Saint, for *S*atellite *I*nspection *T*echnique. It represents this country's first active step to prepare against warfare in space—whether cold war, or hot.

Four Saint anti-satellite spacecraft are being designed and built for Air Force trial by the Radio Corporation of America. Each will be the final stage of a three-stage rocket, with an Atlas booster and an Agena B second stage. From Cape Canaveral in Florida, the satellite



PREVIEW OF SAINT'S LAUNCHING is given by photo of Atlas-Agena rocket combination, poised to put Samos satellite into orbit. Saint will use same rockets, and scene will resemble this.

New menace of bomb-launching satellites spurs Saint project



SATELLITE-LAUNCHED H-BOMB MISSILE, firing retro-rocket, would drop from orbit to target on earth. Diagram of trajectory, above, is based on official one in a recent report warning of

possibility. Missile could be patterned after successful design, shown in cutaway view, of re-entry vehicle used to bring down our Discoverer space capsules from orbit for recovery.



FIRST OBJECT ever brought to earth from orbit was Discoverer capsule. Photo at left shows it being lowered into heat shield that protects it from high temperature and shock of passage through atmosphere. Then parachute opens and lifts it free, for final approach to earth. Discoverer capsules range up to 350-pound size. A version not much larger (600 pounds or more) could hold an H-bomb.

chasers will be launched at three-month intervals, in tests unofficially expected to begin about December of next year.

Trial target for a Saint will probably be a 25-foot Echo-type balloon satellite, or a modified, angled version called a reflector satellite, put into 400-mile-high orbit just before firing the Saint.

To intercept this 18,000-m.p.h. target, the anti-satellite will be rocketed into a position just above and ahead of it. Then, braked by a retro-, or backward-firing, rocket, the Saint will close in upon the target—and approach as gradually as by 10 m.p.h. to within 100 feet of it, for a good look.

The first four Saints will be unarmed.

Their missions will be completed by inspecting the satellites—how, the Air Force doesn't say, but presumably with TV cameras, radar, infrared heat-detecting sensors, radiation detectors.

Later U. S. anti-satellites may be expected to be able to “kill” a dangerous satellite—either by destroying it outright or by subtler ways of disarming it. The Air Force reportedly is studying how to build this “destruct capability” into Saint's successors.

Russia, too, is believed to have an anti-satellite program under way. By unconfirmed but widely credited reports, it will be ready next year to “rendezvous” an interceptor with a satellite—and will

be able to put an unwanted satellite out of business by 1963.

Here are the makings of combat fleets for space—of hostile actions and counter-actions, ranging from sabotage to all-out war. What are the incentives for this strange armament race?

Targets for anti-satellites. Saint will stand guard against the newly recognized danger that H-bombs could be orbited in long-lived Russian satellites—and then, by radio command at any moment, rained down upon the U.S. "For such a bombing system," a recent official report warns Congress, "satellite launchings could be conducted long in advance of a war, in a completely peaceful environment."

To drop a bomb, a satellite actually would launch a missile, which would use a retro-rocket to detach itself from orbit and head for a target below. Any doubt that this could be done was dispelled last August by the first successful U.S. recovery of a Discoverer re-entry capsule—and by Russian recovery of a live-animal capsule. Both were ejected from orbiting satellites, and directed to preselected areas on earth. The Russians claim they brought theirs down only 6¼ miles from the intended landing place; a sizable H-bomb as close could raze a target.

Russia and the U.S. are both known to have studied H-bomb satellites. The Pentagon, so far, evidently prefers earth-based ICBMs. The Russians might decide differently.

That explains why it was disturbing news when, early last year, our radar "space fence" picked up what looked like the first mystery orbiter. The "black" satellite—which Russia hastened to disclaim—turned out to be only a Discoverer



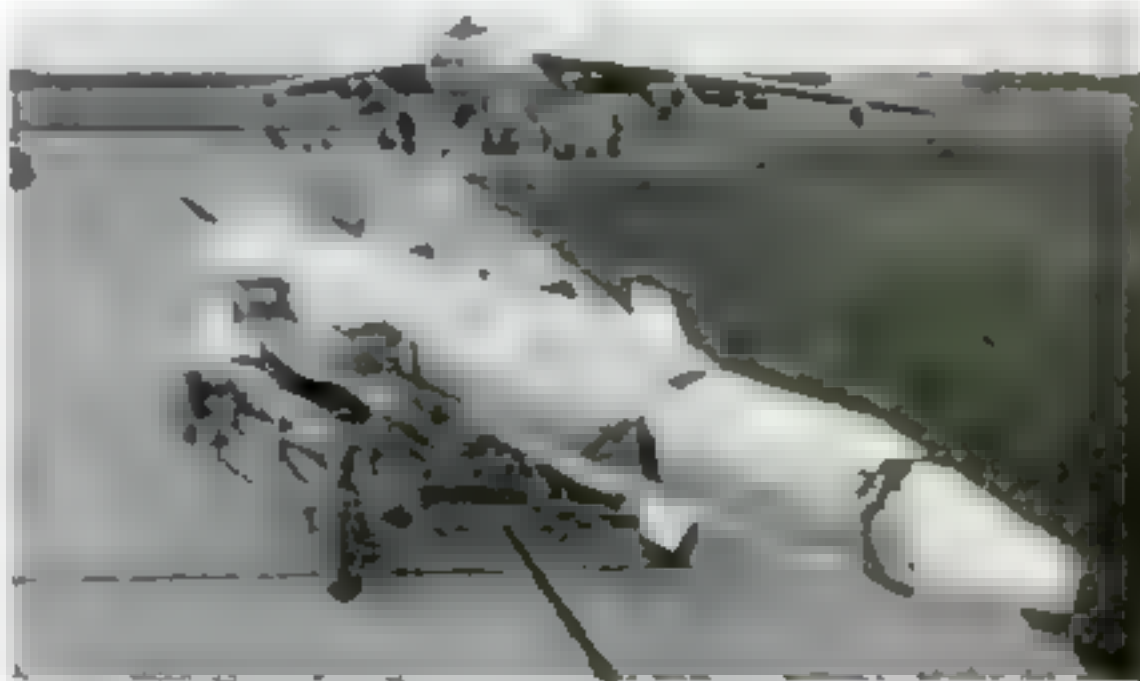
SAMOS PHOTO SATELLITE (being made ready above) has inspired veiled threats in Russian press—and might offer tempting target for Red anti-satellites, believed under development.

capsule astray in space. But the possibility of orbiting weapon carriers will continue to make any unidentified satellite an object of lively concern.

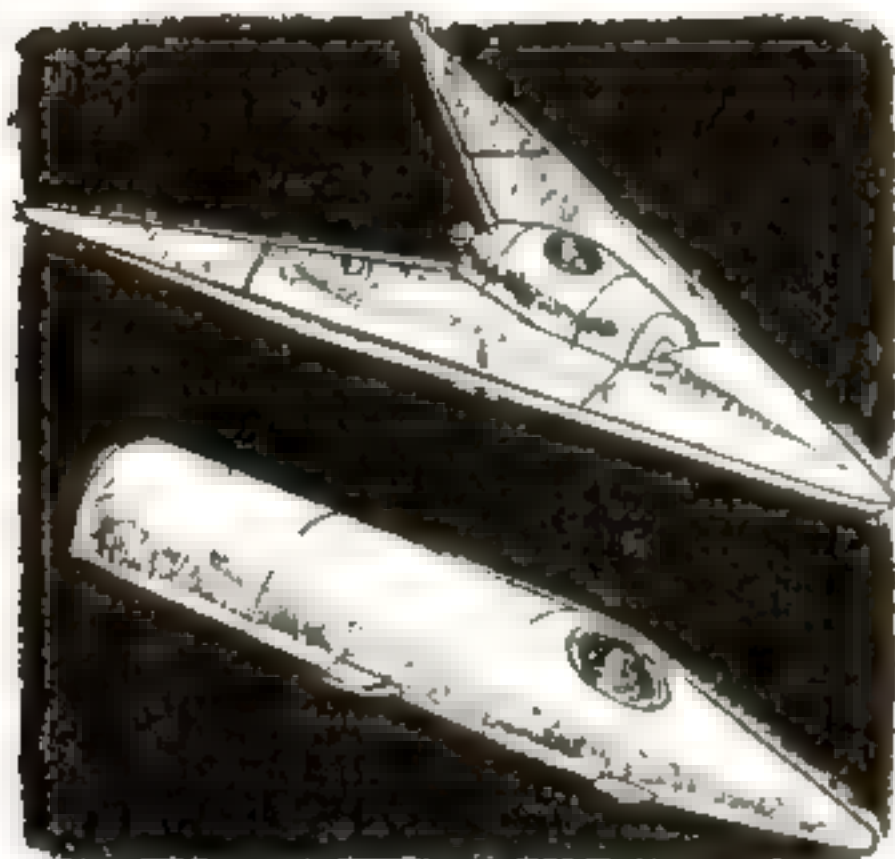
Space blackmail? Another possible satellite threat has been suggested. For cold-war purposes, suppose Russia launched a fleet of mystery satellites, and blandly announced they contained H-bombs. Whether they did or not, they could be used for international blackmail—if the rest of the world had no way of telling.

So a Saint will frisk a suspicious satel-

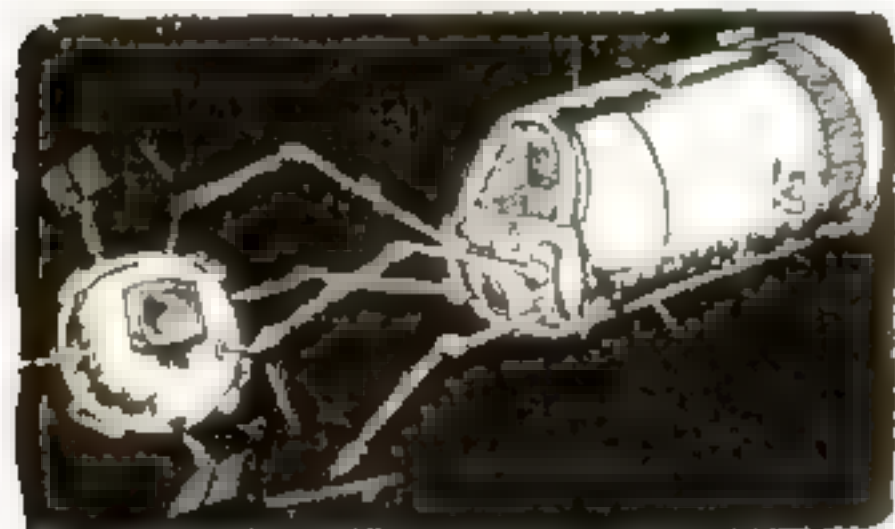
FORERUNNER of U.S. anti-satellite was this 31-foot Martin rocket missile. In pioneering 1959 test of anti-satellite guidance, it was launched from Air Force B-47 plane at 35,000-foot altitude off Cape Canaveral, Fla., and streaked to within about four miles of Explorer VI paddlewheel satellite in 160-mile-high orbit. Nose windows (in photo, covered before launching) were apparently part of a secret homing system.



Manned anti-satellites could use these designs—and tactics



PILOTED SPACE WARSHIPS could look like manned civilian spacecraft for rendezvous missions. Examples: joint Lockheed-Hughes design (top view), General Electric design (lower view).



SPIDER AND FLY: With mechanical arms controlled by pilot, anti-satellite could snip off a satellite's antennas to sever its radio control from the earth, and thus make it inoperative.



"SUNK WITHOUT TRACE": Towed backward to check speed and then cast loose, satellite would fall from orbit, burn up in air. Idea was first proposed to rid space of derelict satellites.

lite for a nuclear bomb—possibly with a radiation detector, or perhaps with a nudge from its rocket exhaust, to see how far and fast the satellite bounces. That will tell if it is heavy enough to contain a bomb. Presumably Saint's armed successors would destroy or disarm an object as dangerous as an H-bomb satellite.

For a Soviet anti-satellite, obvious hot-war targets would be our military satellites—for communications, navigation, ICBM warning, reconnaissance. Might they also offer tempting targets for cold-war depredations?

Last January the U.S. Air Force launched the first of our Samos photo-reconnaissance satellites—which, when fully developed, should be able to take revealing pictures of Russian military installations. While the USSR has made no formal protest, its press is muttering that it will have ways of dealing with these satellites. Should a Samos suddenly and mysteriously go blind, it might be our first notice that Russian anti-satellites were operational.

Perhaps significantly, Samos has one of the first rocket engines that can be stopped and restarted in space—and so could try the first countermeasure against an anti-satellite. By restarting its engine and propelling itself into a new orbit, it could take evasive action to escape interception.

Satellite killers. Anti-satellite weapons for a kill are likely to be decidedly unconventional ones, chosen to suit the target. Despite official silence on the subject, they can be quite reasonably predicted:

- As unmilitary a weapon as a paint-spraying gun could be used to disable a photo satellite, by coating its lenses with opaque paint.

- A large solar mirror would serve as a burning glass to "cook" the heat-sensitive electronic gear of a satellite, and put it out of commission.

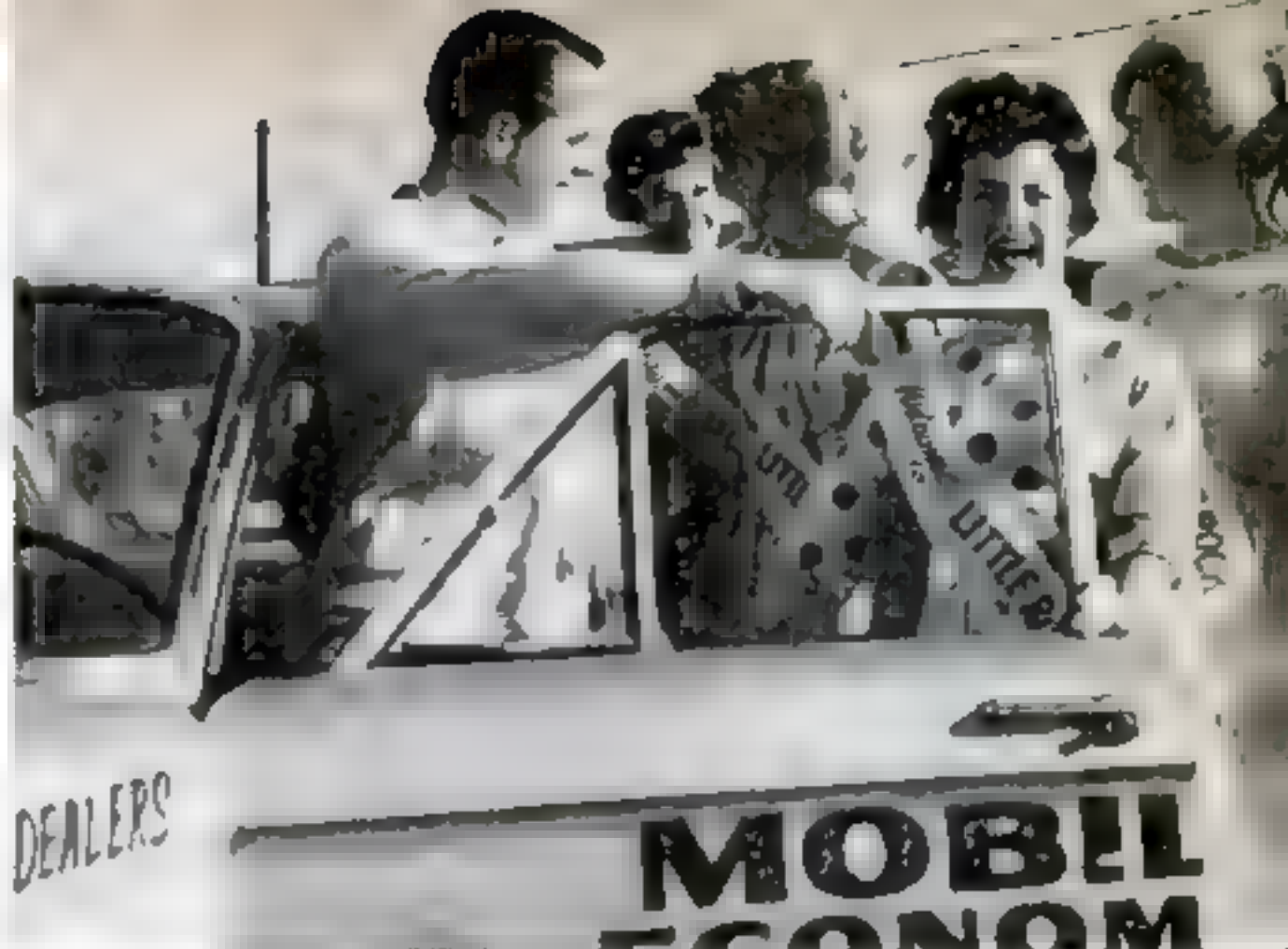
- Hurling sand, gravel, or metal shot toward an oncoming satellite could pit its solar cells and optical equipment, or even riddle it through and through. For dark doings in space, this would have the special advantage of simulating a natural meteor shower. A country whose satellite was the victim could never be sure whether there had been a clandestine at-

[Continued on page 200]



The Winner!

"Staying in high gear as much as possible," said Dan Jones, "is a must for economy." Driving a stick-shift Falcon (above), he posted Run's best mileage, 32.68 m.p.g. He usually upshifted at 11 or 12 m.p.h. and again at 20 to 22. At right, he's being greeted by a toothsome welcoming committee at the Little Rock overnight impound area.



Economy-Run Winners Tell You How to Save Gas

HOW much does it cost you for the luxury of driving without shifting? The recent Mobilgas Economy Run may hold the answer.

This event, a six-day, over-2,000-mile drive from Los Angeles to Chicago via Tucson, Ariz., Roswell, N. M., Dallas, Little Rock, and St. Louis, measured the ultimate gas stinginess of which Detroit's current crop is capable. This year's Run, once again conducted by the U. S. Auto Club, marked its 25th anniversary by

fielding 63 entries—the most that ever competed in the event. All cars were selected from showrooms, and then impounded to prevent alterations from stock specifications.

For the first time in seven years, manual shifts were allowed to compete, though only in the compact class. Size and price determined classes. These were: Class A, manual-shift compacts; Class B, four- and six-cylinder compacts; Class C, eight-cylinder compacts; Class D, stand-



ONLY WOMAN to win first place in a class is Pat Sawyer, whose Corvair Monza chalked up a 29.3539-m.p.g. mark. An automatic-shift fan, she believes that good driving habits are more important for economy than the type of transmission used.



CONTINUED



AUTOMATIC BUICK SPECIAL driven by John Rich (right) with co-driver Jerry Miner actually got better mileage than standard-shift Special. Higher gearing gave automatic an advantage.



OPEN WINDOWS hurt mileage by creating drag, but it gets pretty hot driving with them closed. Here Lee Hamer draws in a big breath of fresh air at the St. Louis overnight stop.



BOTH RAMBLER ENTRIES were withdrawn at starting line following dispute with Run's officials about model types and a new carburetor—officials claimed latter wasn't readily available.

ard-size sixes; Class E, low-price eights; Class F, medium price; Class G, high price.

Results weren't surprising. To no one's amazement, most of the standard-shift cars got better mileage than their automatic counterparts—about two m.p.g. more, on the average. Falcons showed the greatest spread, $5\frac{1}{2}$ m.p.g. The stick Falcon posted the best mileage, 32.6800 m.p.g., while automatics couldn't do better than 26.3467 m.p.g.

Drivers and factory experts interviewed by PS agreed that normally the automatic driver can expect higher gas bills. Barney Navarro, speed-equipment manufacturer who tooled an automatic Buick Special to a close second place in Class C, explains, "The servo pump on an automatic accounts for some power loss. On my Buick Dynaflo, the cooling fins also take a toll. But today's automatics are more efficient than those of a few years ago."

"The basic problem," says Dave Evans, Ford manager of performance and technical evaluation, "is still the relatively poor efficiency of the torque converter at low speed. At higher speeds there's little difference in economy between stick and automatic."

Economy tips for automatics. How can the automatic approach the economy of the stick shift? All drivers agreed on several points. One of the most important is to keep the car in high gear as much as possible. Whenever conditions permit, this means that the car's speed should be maintained at least in the low twenties, above the downshift point. If the transmission has a passing gear, save it for emergencies. Passing and low gears burn extra gas. On most cars, low gear at 20 m.p.h. uses about 50 percent more gas than high at the same speed.

Engine idle is usually set higher on automatics to prevent stalling. But make sure the idle isn't set too high. Keep it as low as possible without stalling.

"Hills should be climbed faster in an automatic," says John Rich, who won in Class C with a Buick Special. "This enables the transmission to lock up and cuts down slippage. The steeper the hill, the faster it should be taken."

General gas-saving hints. "Whether you're driving a stick or automatic, the biggest enemy of economy is the brake



ACCURATE MEASURING of gas was assured by bubble levels and screwjacks on special gas tanks. Temperature was recorded with a thermocouple.



HOODS of all entries were sealed with wire at each impound area to prevent tampering. Here Chevrolet hood is battened down at Little Rock.

HOW THEY RAN IN 1961

COMPACTS, MANUAL TRANSMISSION	Driver	Miles per Gallon
FORD FALCON	Dan Jones	32.6800
FORD FALCON	Dick Lyman	31.6199
CORVAIR	Ronnie Kaplan	30.7907
COMPACTS, FOUR- AND SIX-CYLINDER		
CORVAIR MONZA	Pat Sawyer	29.3539
CORVAIR MONZA	Bill Horton	29.3267
TEMPEST FOUR	Jim Nelson	27.4406
COMPACTS, EIGHT-CYLINDER		
BUICK SPECIAL	John Rich	25.0929
BUICK SPECIAL	Barney Navarro	24.6756
TEMPEST EIGHT	Joanne Cole	24.0747
STANDARD-SIZE SIXES		
PLYMOUTH SAVOY	Art Rane	23.1540
DART SENECA	Woody Bell	23.0156
MERCURY METEOR	Frank Hainley	22.5656
LOW-PRICE EIGHTS		
FORD FAIRLANE	Byron Froelich	21.3314
PLYMOUTH SAVOY	Mary Davis	21.2129
FORD FAIRLANE	Robert Rice	21.1649
MEDIUM PRICE		
CHRYSLER NEWPORT	Mel Alsbury Jr.	19.9954
PONTIAC STAR CHIEF	Mel Chastein	19.6093
PONTIAC STAR CHIEF	Mickey Thompson	19.5897
HIGH PRICE		
CADILLAC	Lee Hamer	18.9253
IMPERIAL CUSTOM	George Alsbury	18.7360
LINCOLN CONTINENTAL	Jim Fosdick	17.2329

pedal," says Navarro. "Too many drivers forget to synchronize speed with traffic lights."

John Rich gets up to speed "fairly briskly" from a standing start. "I don't pamper the car when I pull away. Of course, that doesn't mean jack-rabbit starts," he adds. "But it's best to keep up with traffic. Cruising speed is important, too. On a flat stretch, the most economical speed is in the 32-50-m.p.h. range. Above 50, gas mileage drops way down."

Lee Hamer, who squeezed nearly 19 m.p.g. out of his Cadillac to sweep Class G, reinforces that idea. "It's after you've reached cruising speed that you really have to be careful," he says. "Punching the throttle feeds the engine more gas than it can use."

"You have to drive like a little old

lady," advises Ed Dempsey, Navarro's co-driver.

If you use all these hints, can you expect mileage figures comparable to those of the Run entries? Probably not, unless you're an economy fanatic. The drivers in the Run used tricks the average driver would want no part of. Windows are kept closed even in the hottest weather to cut down wind resistance. Heaters, radios, and wipers go unused for fear of draining precious power. Cars are in perfect economy tune—hardly practical for everyday driving.

Are automatics here to stay? Definitely, according to Detroit production figures. In the last two years, 75 percent of all American cars had automatic transmissions. Most motorists, it seems, don't mind paying a bit more for no-shift driving.



Anti-Roll Tanks Banish Seasickness

Water ballast, pouring to the high side when she starts to roll, holds big liner steady

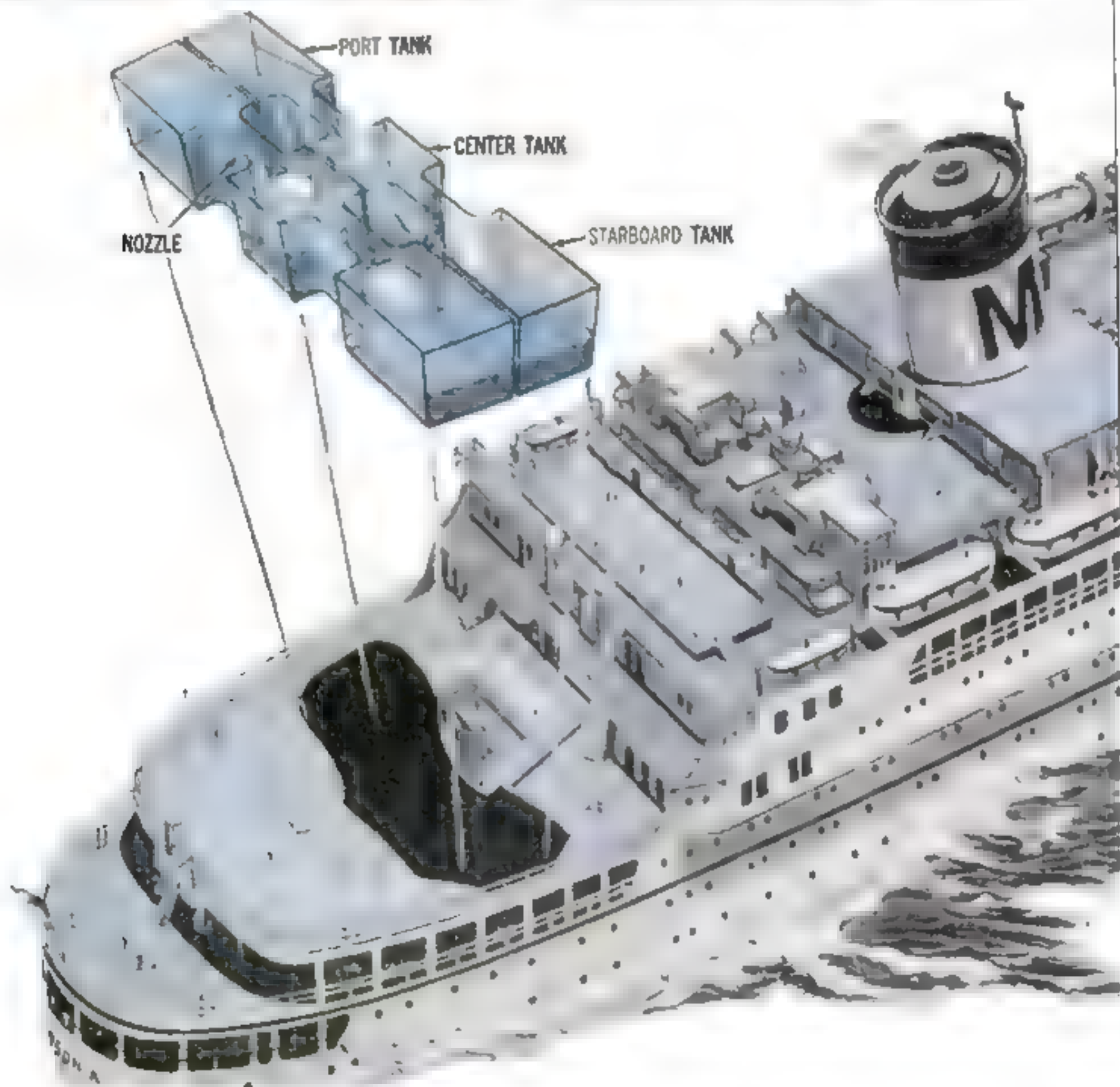
By Henry B. Comstock

SEASICKNESS missed the boat when the S. S. Matsonia steamed out of San Francisco recently. On a 13-day voyage to Honolulu and back, the

27,000-ton luxury liner plowed through waves that should have rolled her nine degrees—double the motion at which most tourists' tans turn to green.

But the big Mat never nodded more than $1\frac{1}{2}$ degrees. Requests for Dramamine pills reached an all-time low. Storm damage to crockery fell 90 percent—no small item. On a Matsonia, the bill can come to \$50,000 a year.

What kept the landlubbers on their sea

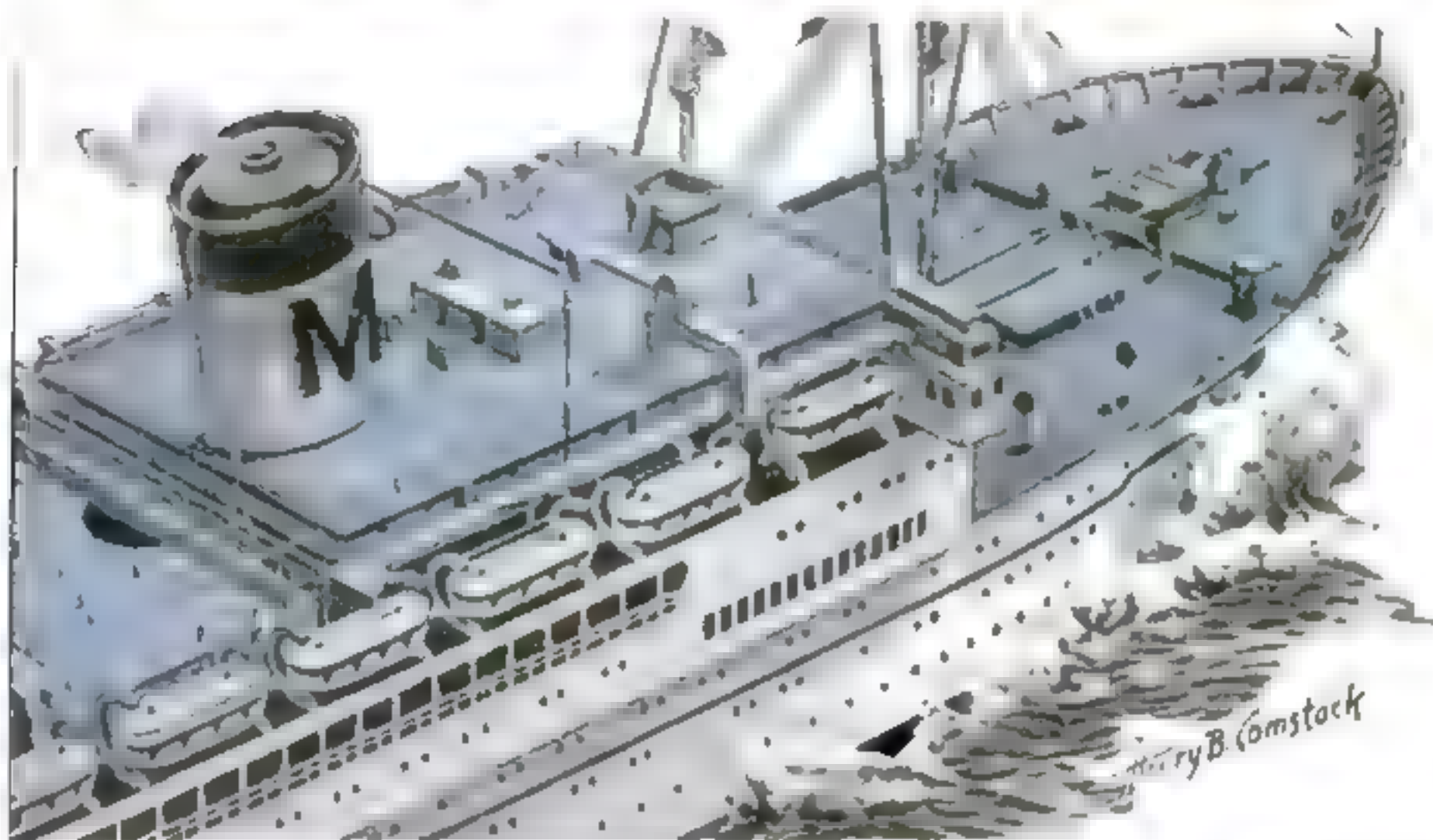


How the stabilizing tanks stop sway in heavy seas



DELAYED SHIFTING OF WATER in Flume Stabilization System counteracts force of cross waves. As ship rolls (toward a plane perpendicular to

wave surface), water in tanks begins shift to the low side. Delayed by flumes, it takes effect after ship has begun its counter-roll.

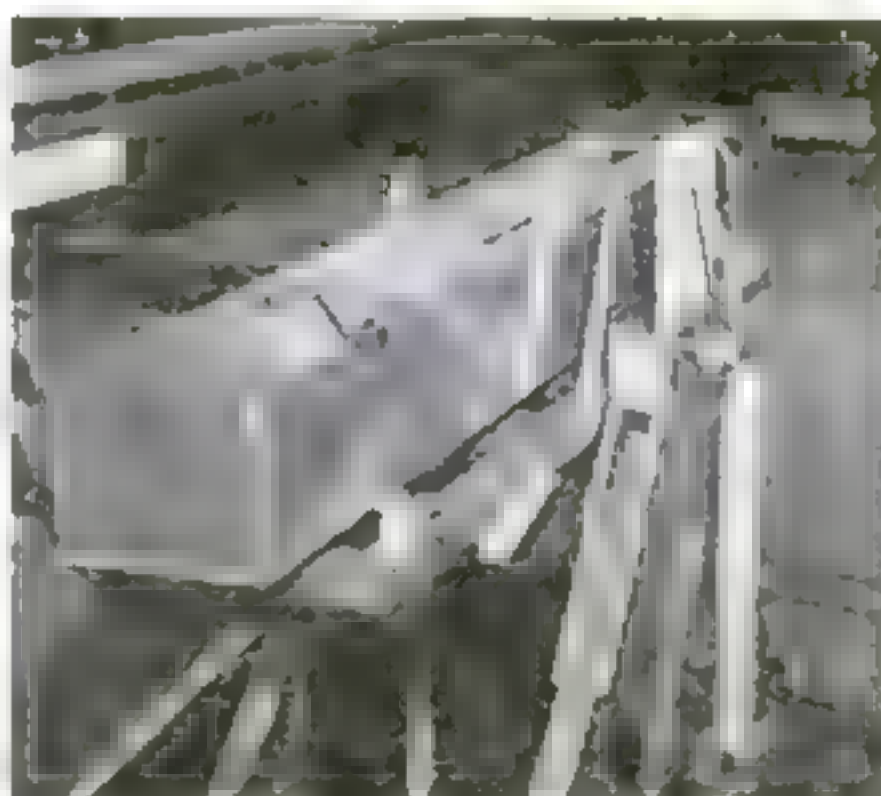


legs was a new stabilizing rig just installed below the afterdeck. Mechanically it was unexciting. There were no whirling gyroscopes or huge hydraulic cylinders tilting external fins. Instead, a couple of boxlike containers stretched 70 feet across the hull at waterline. Each was pinched in so sharply at two points that it became three reservoirs connected by passageways.

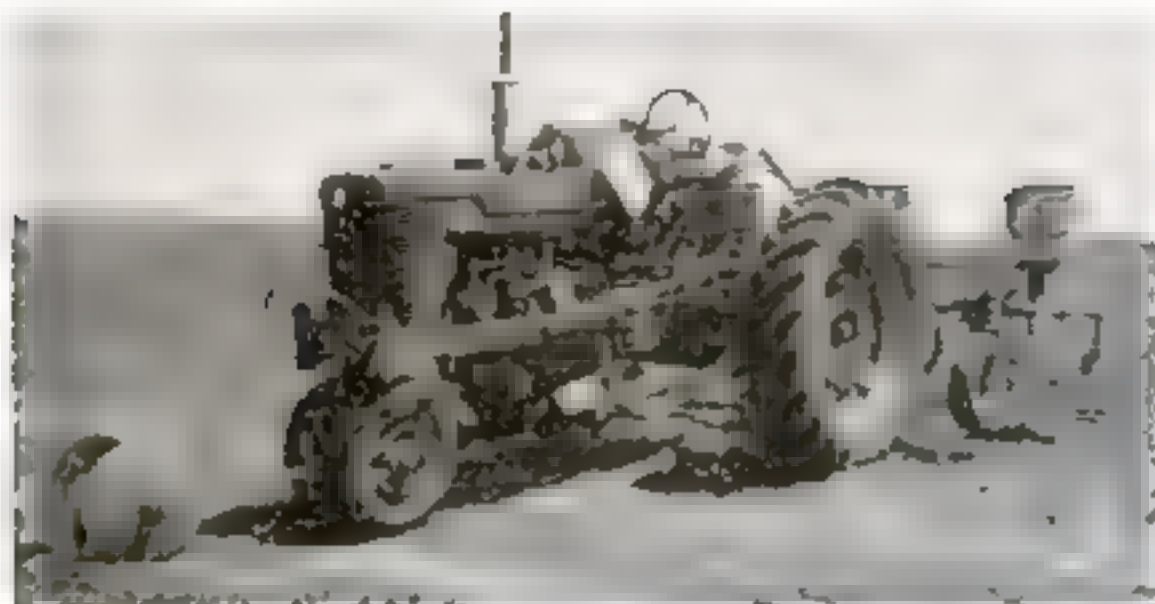
Engineers of John J. McMullen Associates, designers of the anti-roll device, called each pair of mated reservoirs a "tank," the narrow passageways "nozzles," and the whole setup a "Flume Stabilization System."

After welders at the Bethlehem Shipyard in 'Frisco had assembled the unit and beaded it in place, it was filled to

[Continued on page 202]



COMING UP: DIRTY WEATHER. Model of Matsonia's tank is bench-tested at Stevens Institute of Technology. Under controlled rocking, the behavior of water is measured electronically.



CANTED GUIDE WHEELS are mounted ahead of the front axle. Toed in at the leading edge, they keep the tractor in a furrow.



NO HELPING HAND NEEDED: Farmer can leave the wheel, follow behind the machine to check how seed is being covered.

Automation on the farm

Many farmers in Texas have constructed their own automatic tractor guides to help with spring planting. Using the tricky devices, one man can sow corn, cotton, or grain sorghum without the need of a helper to steer or check seeders.

A typical farm-built guide is shown at left. This one consists of two steel disks canted inward at five degrees on an axle to prevent creeping out of the furrow. Between the hubs is a 40-inch push rod clamped to the front tractor axle and hinged to allow raising when not in use. This one is operated by the original implement lever by means of a rod attached to a lifting frame and chain. Others work on the power lift or a hydraulic cylinder. All are made of scrap parts.



Dual-control casting

Even if you have never fished before, you can learn fly casting with the flick of a wrist on the new machine above. It works like the dual controls on a car for teaching new drivers. The pupil is forced to follow the wrist movements of his instructor coupled to him by his side.



Interchangeable truck top

This aluminum canopy is light enough to be lifted on and off by four men, one at each corner. It can be transferred from one half-ton vehicle to another. Designer of the lightweight top is Capt. M. W. Dickerson of the Tactical Air Command, Langley Air Force Base, Va.

New Ideas from the Inventors

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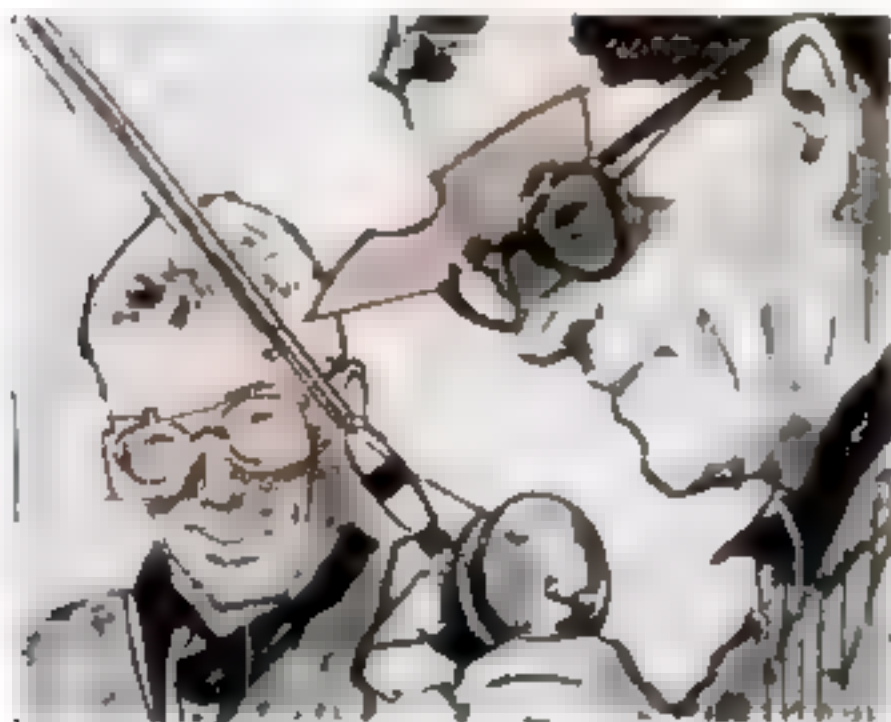


Piston Adjusts Outboard Depth. Instead of tilting or stopping an outboard to prevent prop fouling, you could just pump it upward on this recently patented bracket

and keep it running. By forcing fluid into —or out of—two cylinders, a lever would raise or lower the mount and the outboard motor that was clamped to it.

Visor Doubles as Sun Lens. With this hinged visor clipped to the frame of his regular glasses, an eyeglass wearer could see equally well in shadow or bright sunlight. Pulled down, the tinted plastic would shield the lenses; flipped up, it would admit light while cutting glare.

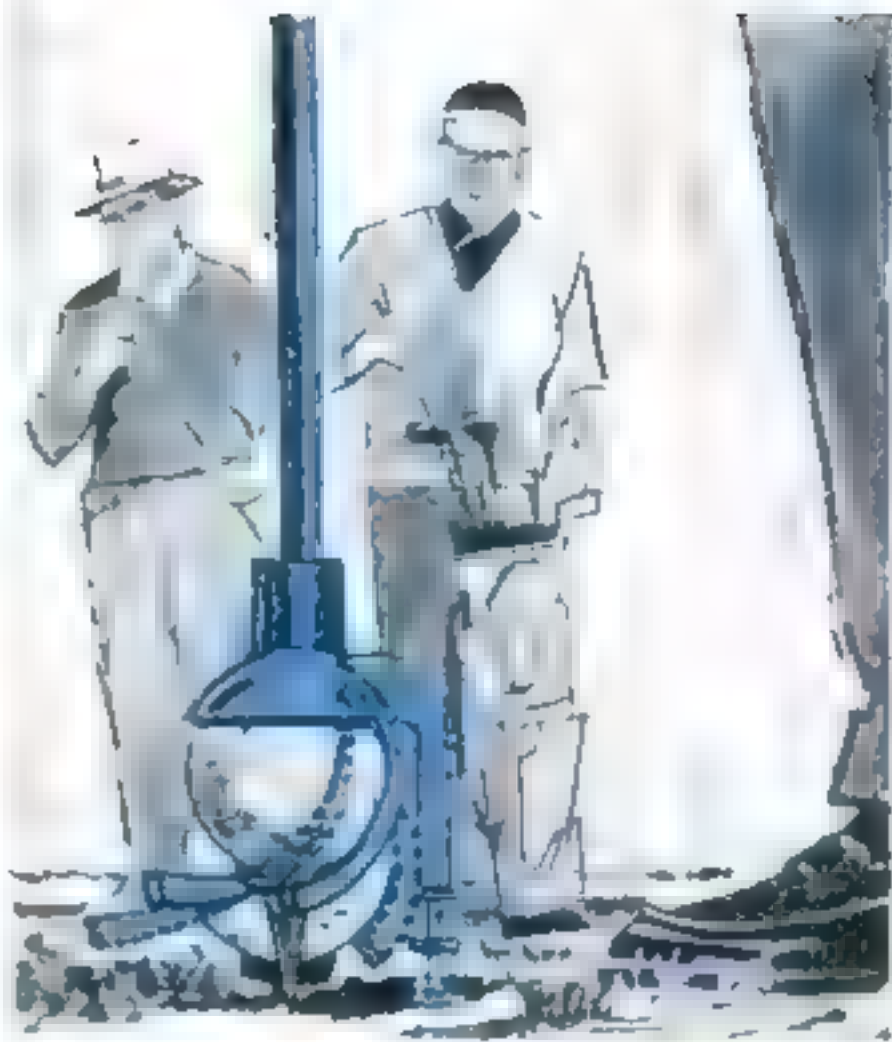
Striped Window Improves View. A rear mirror that gives you a good rear view, says this GM patent, usually blocks part of your view ahead. It could be placed high and clear, however, if lenslike, refractive strips in the rear window corrected the mirror's downward-tilted view.



More Inventors' Ideas



Tape Monitors Your Suntan. By keeping tabs on time and intensity of exposure, a tape-backed strip coated with different photo emulsions would let you acquire a tan without risking a painful burn. As each emulsion "developed," an appropriate warning would become visible.



No-Stoop Gripper Tees Golf Ball. You could set up a tee and golf ball without bending if you put a gripper like this on your club handle. You'd place ball and tee between the claws and press the tee into the ground. A ground-contacting plunger would then open the claws.

Hose Air-Conditions Second Room. A single air conditioner might cool different rooms at different times if it had an attachment like this. A plastic hood, fitted

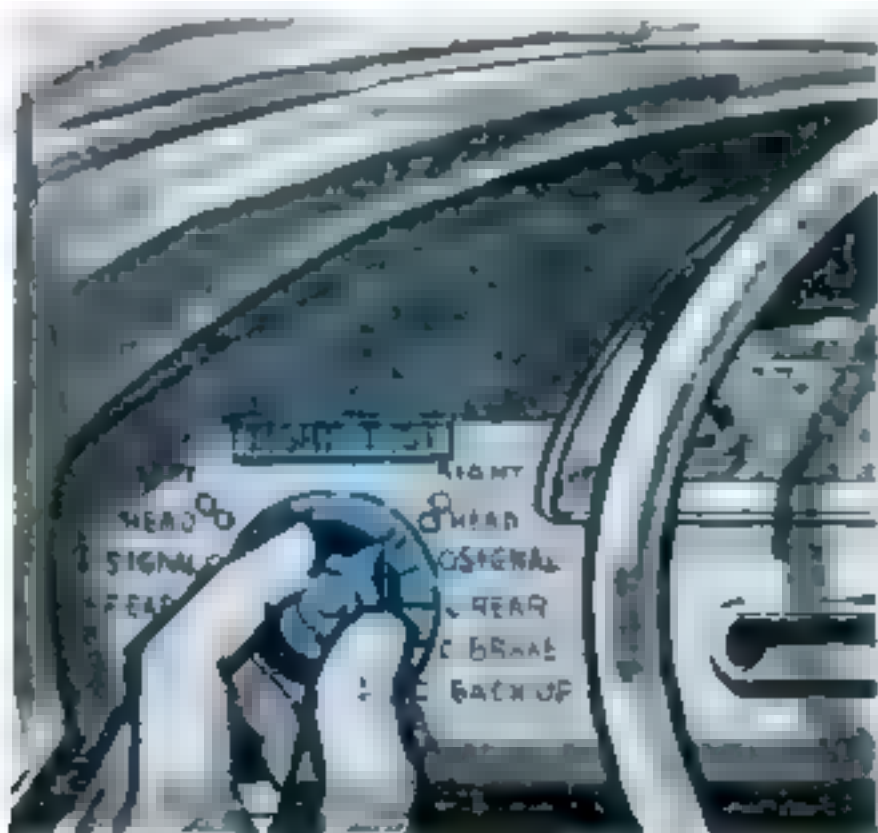
with a hose coupling, would funnel cool air into a long hose. By taking the other end of the hose along, you could pipe better weather to an adjoining room.





Crib Unfolds Into Play Pen. You'd need less space for baby's basic furniture if he could sleep and exercise in one combination unit. To convert this play pen into a crib, you'd fold in half two hinged sides and the base. The legs would extend to bring the unit to crib height.

Pilot Light Tests Car Lights. New cars have so many outside lights that you can drive for quite a while without knowing that one of the filaments has burned out. But you could tell their condition at a glance if each light were connected through this selector switch. You'd dial each switch position in turn; if it were working, an indicator would glow.



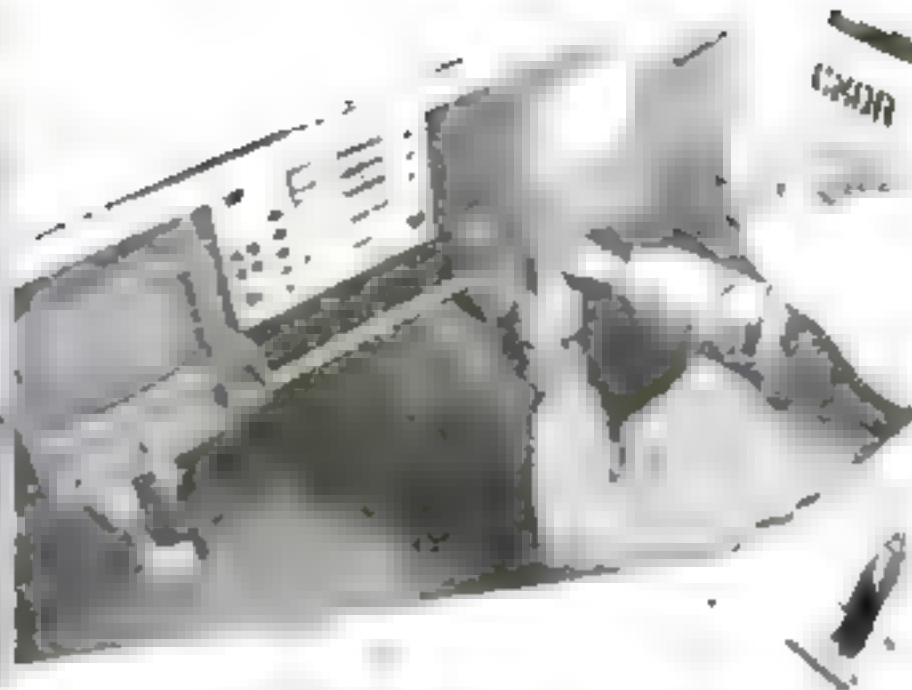
Gauge Shows Diver's Depth. This wrist gauge, using a new principle, has its Bourdon tube encased in oil. The oil transmits water pressure on a flexible membrane outside to the tube inside. Deflection of the tube, in response to pressure, would move a dial pointer.

The following patents have been issued on these inventions: Motor mount—No. 2,815,731 to G. Curtis, Houston; Visor—No. 2,825,966 to L. Chundrak Jr., Portland, Ore.; Car window—No. 2,953,961 to A. T. Court, Detroit; Sun tape—No. 2,949,880 to Stephen Fromer, NYC; Golf gripper—No. 2,943,856 to G. Esmerman, Milwaukee; Air hose—No. 2,824,575 to Shy Rosen NYC; Play Pen—No. 2,815,526 to J. Zimmerman, Mansfield, Ohio; Light tester—No. 2,841,780 to K. Norton, El Paso, Tex.; Depth gauge—No. 2,935,873 to T. Stewart, Lakeside, Calif.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.



TV CAMERAS and power equipment are mounted on top of a medium tank for testing. In actual combat they would be inside the vehicle.



TWO VIDEO SCREENS give commander and gunner a clear view of battlefield. That for the commander is at right, for the gunner at left.

Tank maneuvering by television

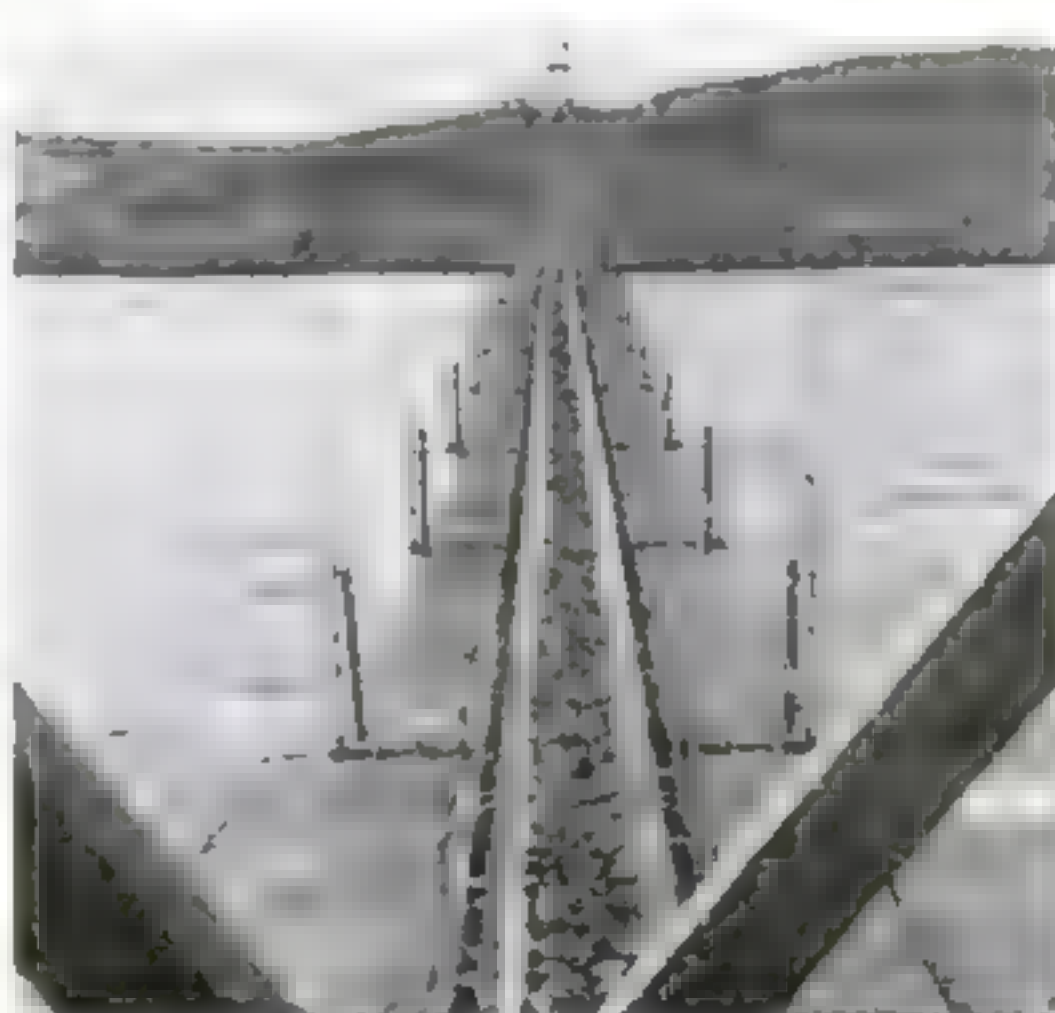
Latest innovation for tankmen is "blind driving." The men scan the terrain on a TV screen. First tried out on trucks, the equipment has been mounted on Patton medium tanks now undergoing field tests at Aberdeen Proving Ground,

Md., and the Ordnance Tank-Automotive Command in Detroit. The sealed-in tank-driving system is intended to protect crews from battlefield radiation, and permit observation while preventing eye damage from the flash of nuclear blasts.



Light-bearing "cactus"

The street light above is 30 feet tall and the only one in Phoenix, Ariz., that resembles a saguaro cactus. Built of lengths of corrugated sheet metal, it stands in front of the office of the Junior Chamber of Commerce. Instead of white saguaro blossoms—the official state flower—lamps bloom on its branches.



Rock hauled by long bridge

Army engineers built this 930-foot suspension bridge across the lower Snake River near Pasco, Wash., to carry sand, gravel, and rock from their aggregate pits on one side of the river to the concrete batching plant shown in the distance on the other side. A 30-inch-wide endless conveyor belt, slung between catwalks and traveling at 300 feet a minute, moves 660 tons in an hour. Before its work is finished, the moving span will transfer 1½ million tons to a dam project on the far side.



How They Rebuild Automatic Transmissions

Transmission troubles are no longer a major catastrophe. Here's how they fix 'em now

By Herbert R. Pfister

PS PHOTOS BY W. W. MORRIS

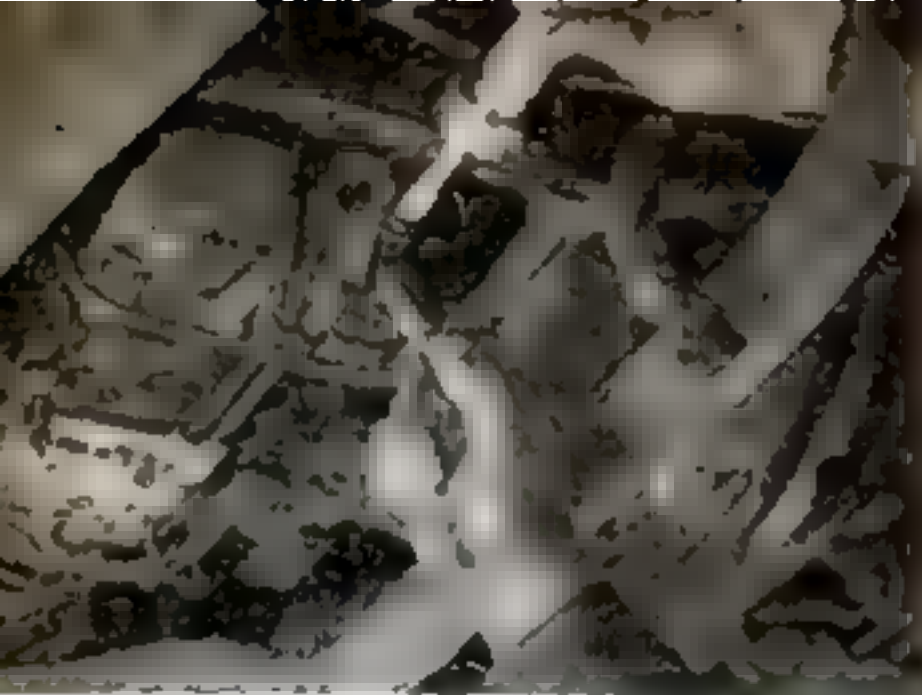
SOONER or later, if you drive a typical automatic-shift car, you'll be faced with the prospect of having the transmission repaired or adjusted.

Chances are you'll shudder at the thought because for years ugly stories have circulated about the cost and unre-

liability of automatic-transmission repairs. After listening to them, you may feel you're going to be lucky if the bill is only a few hundred dollars.

This service nightmare did exist, but today the picture is changing with the growth of a new industry: transmission rebuilding. Parts are packed into an automatic transmission so compactly that it's necessary to tear it almost completely apart to get at the insides. Once a unit is torn down, it takes only a little more work to rebuild it entirely instead of just replacing a bad part. You can have a completely rebuilt transmission

CONTINUED



BAND ADJUSTMENT is the most common routine service item. Here a gauge and special torque wrench are being used to take the guesswork out of front-band adjustment on a Ford.



EIGHT FORDOMATICS are about to become a basketful of parts. This disassembly bench is the only dirty spot in the shop. The old units are dismantled here prior to cleaning.

BUICK VALVE AND SERVO BODIES get new gaskets and parts on this bench. Masterpieces of compactness, these castings have many channels for routing transmission fluid through the unit. Hydraulic equivalents of a printed circuit, these units take the place of what would otherwise be a tangled mass of tubing and fittings.



installed for little more (and often less) than the cost of repairing your old one.

Recently I spent several days at the Myles-Martin Company in New York, a fast-growing specialist in the field. This growth, incidentally, hasn't been easy. Reputable firms have had to live down the bad name earned during parts-scarce war years by villains in the rebuilding business—fast-buck operators who dunked fuel pumps, carburetors, generators, and other hard-to-get parts in solvent, then painted over grit stuck in the corners.

Lee Myles, a musician in the days when name bands were on their way out, recognized the need for quality rebuilding—"rebuilding with a conscience," he calls it—when he first began selling auto parts to fill in between bookings. With assistance from Fred Hertel, a transmission engineer and now vice president of the company, he set up a small rebuilding shop in Brooklyn.

The production-line way. Emphasis was on cleanliness—an unfamiliar idea to many mechanics of that day—and precision, which meant that parts had to fit as closely as when they were new. The shop grew along with his reputation. Soon it was moved to a larger building, where assembly lines were set up for rebuilding groups of 10 or 12 identical units at a time. Today the shop can turn out 40 "rebuilt" a day.

Touring the plant, we passed what looked like a graveyard of old transmissions. There were hundreds of them piled on steel shelves and overflowing onto the floor.

GROUP OF FORD CLUTCH ASSEMBLIES reaches final assembly bench completely rebuilt and fitted to their planetaries. Governors, valve bodies, and servos also come assembled from other points in the line, ready to be installed in their cases. Bins at rear of bench hold small parts and bolts needed to put units together.





BEFORE: Old transmissions are sorted into groups of a kind as they are received. When six or more similar models accumulate, they are started along the rebuilding line as a group.



AFTER: Painted and ready for a fast swap, these "rebuilt" units will often outlast the cars they go in. Lee Myles, above, gives a written warranty for six months or 10,000 miles with each unit.

"That's no graveyard," Hertel said. "Those are the raw materials of our business. Most of them are from the rush we had after the storm last week." He shook his head. "People sure wreck these things when they get stuck and try to rock the car out. They should realize they can't spin the wheels at 30 miles an hour and then flip to reverse without chewing up the box. Some of these have been shifted back and forth so violently that the insides have broken away from the housing."

In a corner some men were busy taking apart old transmissions and piling the parts into baskets. After cleaning and inspection, many parts would be discarded. Others, suitable for re-use, would be cleaned again, sorted, and stored in bins. From these bins and from the new-parts room, skilled assemblers would se-

lect parts needed to put together a new group of transmissions.

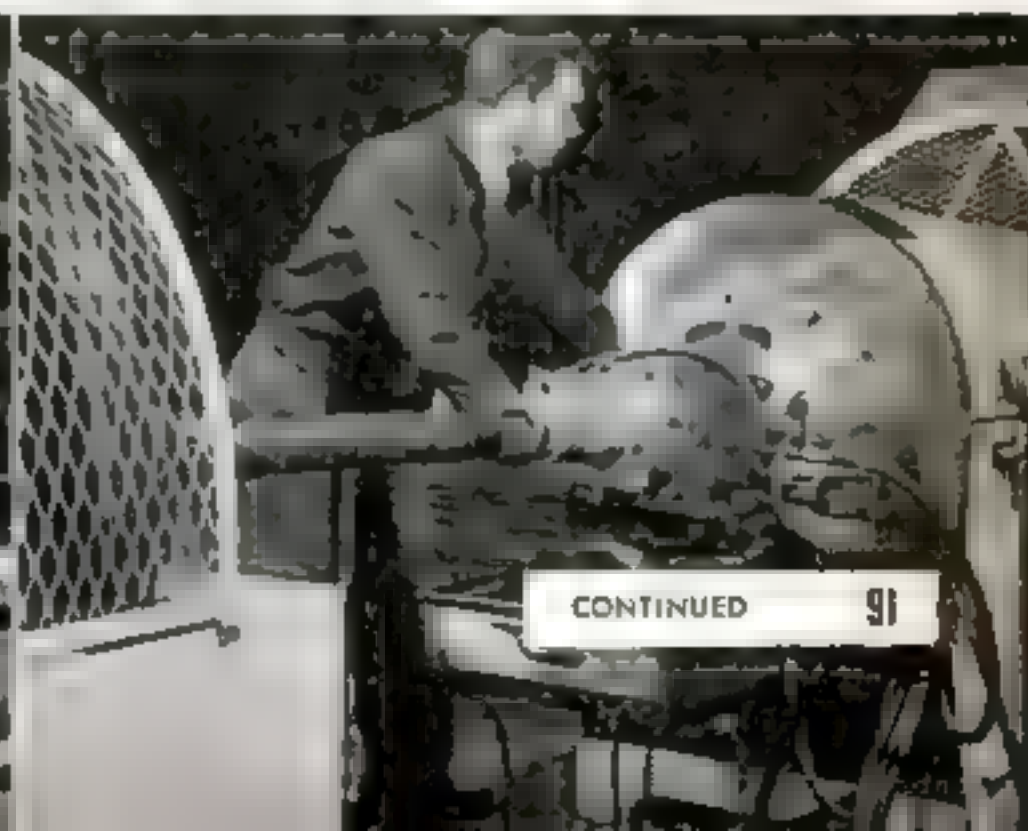
These assemblers have been trained to identify on sight any of the parts of the 250 different transmission models manufactured since 1939. It takes five years for a man to reach this expertness, and some never do.

Licking the installation problem. Until a few years ago, the entire output of rebuilds was shipped to jobbers, who distributed them to repair shops. This brought a problem: Improperly installed or hooked up to defective drive trains, many boxes would come back leaking or damaged.

To reduce the number of returns, Myles built an installation shop next to the rebuilding shop. Then he trained mechanics in the art of installing and servicing transmissions. With 18 special

EIGHT FOR THE ROAD: These Hydramatics will be buttoned up as soon as this man finishes installing main control-valve bodies. Basic adjustments, made with gauges as parts are installed, seldom require changing. Fine adjustments are made, if necessary, after units have been checked under road conditions.

UNITS GET FINAL CHECK on dynamometer-type machine called a Dytranizer, developed to simulate loads placed on transmissions when moving the car in all speed ranges. Quick-connect hoses link the parts of the hydraulic system to a panel of gauges that read operating pressures inside the unit under road-test conditions.



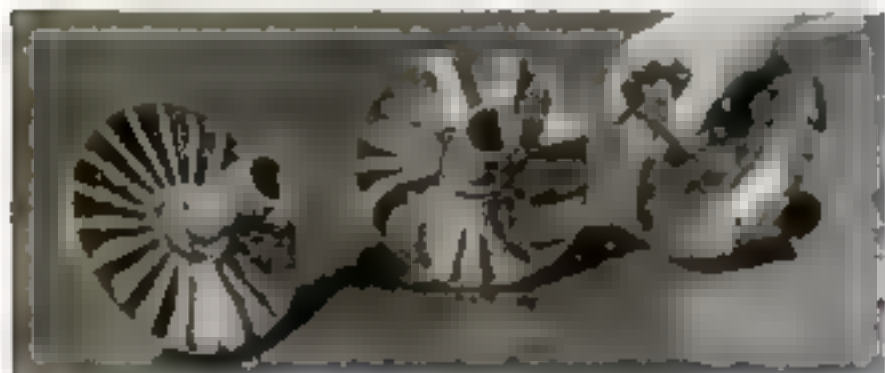
Torque converters get the treatment, too



TORQUE CONVERTER is the fluid coupling between engine and transmission. Some, like these Chrysler converters, are factory-sealed. The rebuilder cuts them open, restores their innards, and then welds them back together.



AUTOMATIC WELDER is resealing this converter. Hand welding could do the job, but a jig built onto the machine rotates the housing while flux and rod are fed in measured quantities to produce a perfect bead in one minute.



A CUTE TRICK that helps explain the success of good rebuilding is shown above. Usable sections of two damaged fluid couplings at right are salvaged to make one good coupling, shown at left, for a Jetaway transmission.

lifts working five days a week, he now uses most of his rebuilds in his own installation shop.

Each year the shop is visited by automatic-transmission engineers from Detroit. Myles is particularly proud of this, but it's not as surprising as you might think. In the "graveyard" and on the rebuilding benches lie the remains of some engineering theories that didn't stand the test of time, wear, and normal abuse. The place is a field laboratory for car builders.

Hertel particularly enjoys one story he told the engineers recently:

"This fellow drove his car for three years and never knew anything was wrong until he brought it in for a band adjustment. We found the unit was not shifting into second and fourth. Disassembly showed that two pistons still had burrs on one end, indicating they

[Continued on page 224]

How to prolong the life of an automatic transmission

If you must get away fast, do it by pressing the pedal to the floor. Taking off in Low, then flipping into Drive when the engine winds out, is a shift not controlled by the governor. Bands and clutches wear fast.

That jolt you receive when you first shift to Drive or Reverse with a cold engine can do damage. Drag created by thick fluid and twice-normal idle speed spins parts that normally would be motionless, causing hard band engagement. So don't be an eager-beaver starter. Wait a few minutes until the engine warms to normal idle.

In bumper-to-bumper summer traffic, shift to Neutral when at a standstill. Prolonged idling in Drive causes overheating, foaming, and loss of fluid.

The trick of revving the engine in Neutral, then shifting into Drive for a squealing getaway is guaranteed to pull out band anchors, burn the clutches, or mangle the gears.

If your transmission acts up, have it looked at without delay. Repair bills rise in proportion to the miles driven after the first indication of transmission trouble.

Don't doctor your transmission with cleaning solvents or sealers. Anything that will swell worn seals or remove varnish will also affect operating rubber parts that shouldn't be swollen.

Gyro assembled under microscope

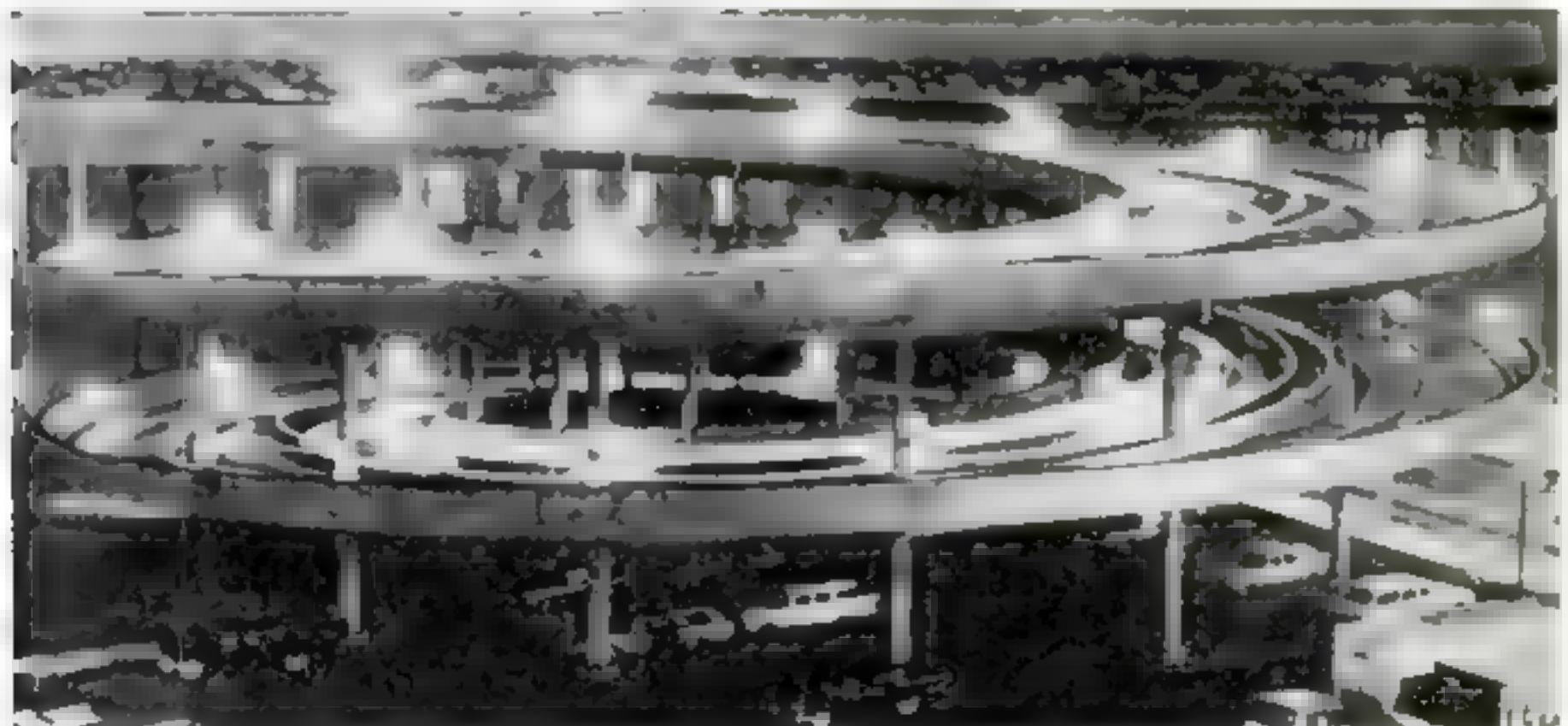
The eerie appearance of the technician at right is due to a masked microscope he uses while assembling a miniature gyroscope in a dustfree chamber.

Sperry Gyroscope Co. developed the tiny device for use in missile inertial-guidance systems. It's so sensitive, engineers say, that it would enable a spaceship to land within a mile of a predicted site on the moon.



Chain mail for tires

Armor mesh protects heavy-duty tires on British road machines from cuts and abrasions when clearing sites littered with rubbish and rocks. Made of high-tensile manganese steel, the chain-mail coverings are long lasting and easy to fit on.



New approach to parking

The spiral stream of light in the night scene above is made by cars rounding a

ramp to reach a parking lot built on the roof of Detroit's Cobo Hall. The Detroit River and the skyline of Windsor, Ontario, are visible in the background.



Prefab Plastic Cottage

Build a foundation platform, and you and a helper can put up this vacation home in a weekend. Its plywood-faced, foam-core-insulated plastic panels are precut to fit. Included are doors, win-

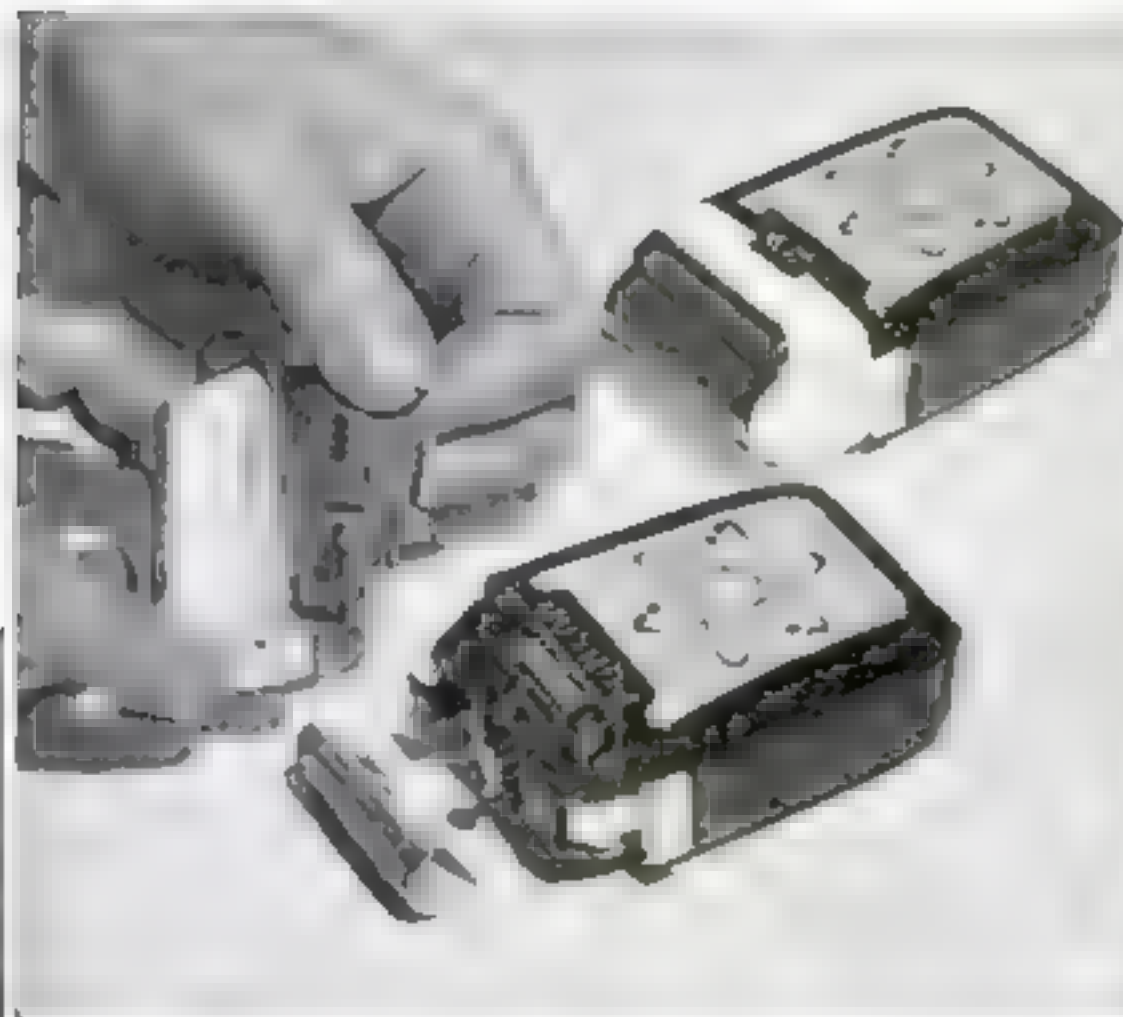
dows, interior and exterior trim, splines for joints, hardware, and nails. Four sizes: 16-by-16 to 16-by-28 feet, \$1,000 to \$1,600, plus freight. Koppers Dylite Plant, Box 57, Harper Station, Detroit.



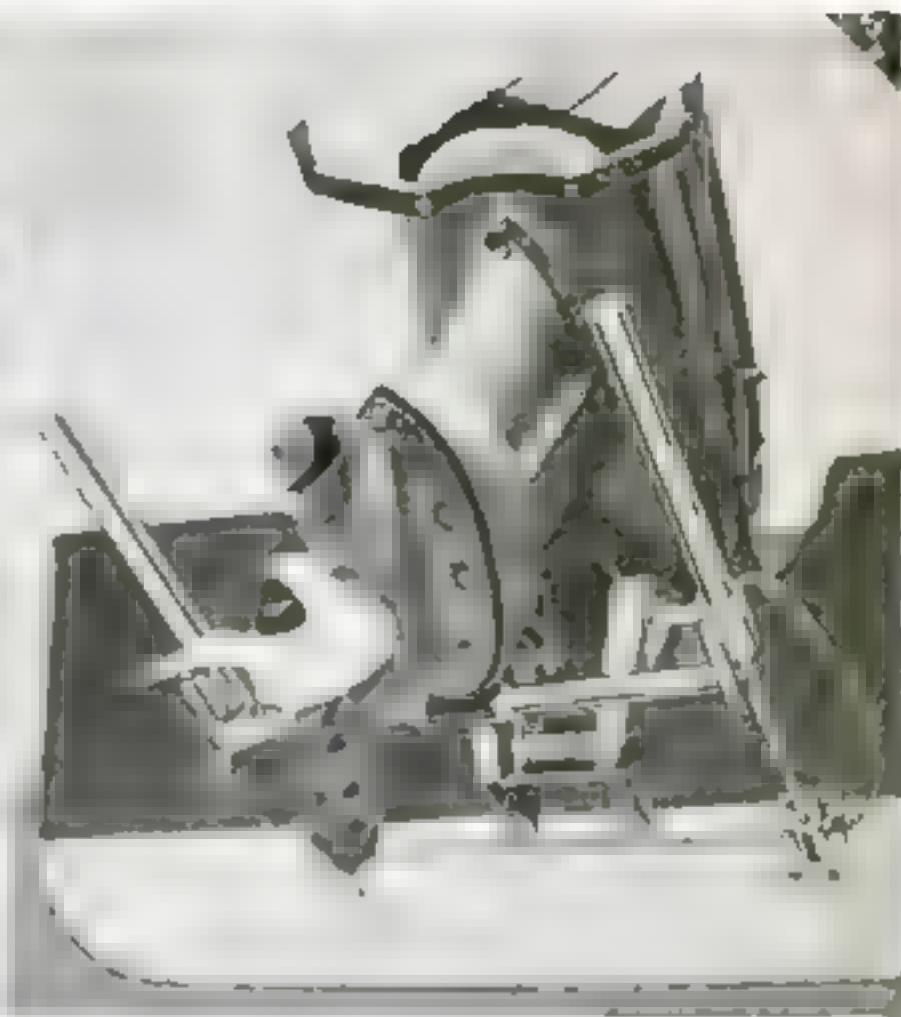
GROMMET KIT contains all you need for repairing and making alterations on canvas: inserting die, hole cutter, hardwood block, four dozen grommets, and instruction sheet. The tools are almost identical to more expensive ones used by professionals. For holes of $\frac{1}{4}$ - to $\frac{7}{16}$ -inch diameter, \$2.85 to \$3.50, plus 75 cents' postage. Morsan Tents, 10-27 50th Ave., Long Island City, N. Y.



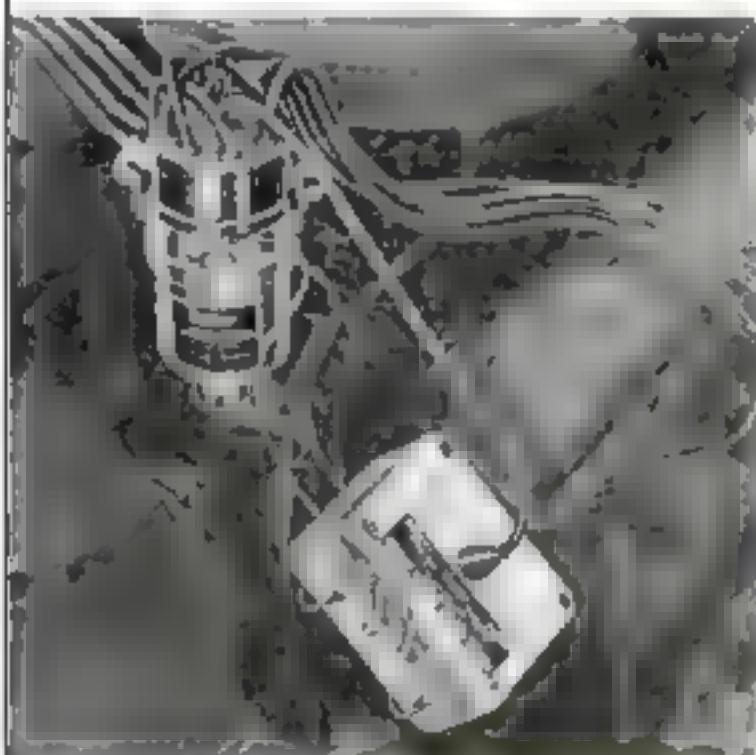
SELF-LIGHTING TORCH fires automatically on battery when you press trigger, goes out when you release it, thus saving on fuel. The Prest-O-Matic tool burns acetylene gas and has a tip temperature of around 4,000 degrees, good for such jobs as brazing, soldering, and tempering light-gauge metals. With three tips, torch sells for \$24.95. Navan Products, Inc., El Segundo, Calif.



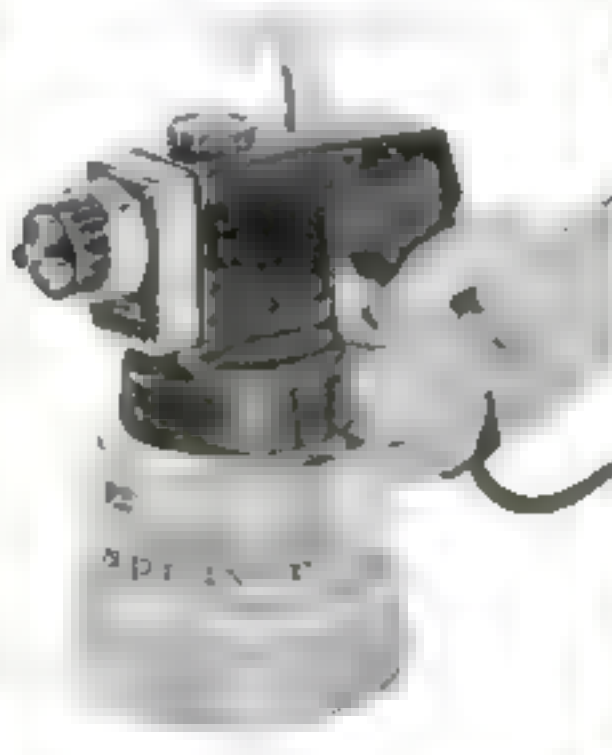
DO-IT-YOURSELF SHAVER has a cutter and screen you can replace without going to a service station. The CFL-Mark II is powered by a new, quiet motor, has a head of Du Pont's tough Delrin plastic instead of metal. Price, \$23.50; extra cutter and screen, \$3. Ronson, 1 Ronson Rd., Woodbridge, N. J.



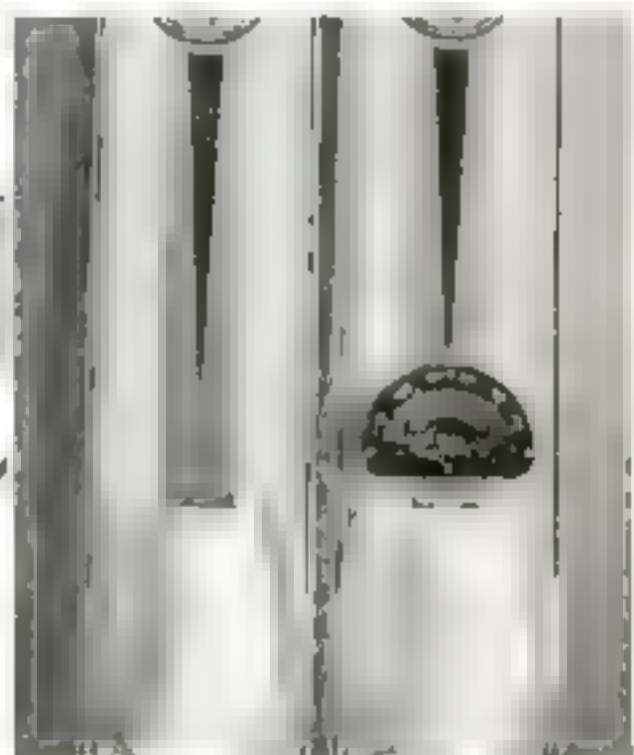
OUTBOARD TILTER is powered by carbon dioxide. A pushbutton at the steering wheel releases the gas into moving cylinders to raise or lower a motor to any position. You can install the tilter in minutes. Painted, \$74.50; chrome, \$89.95. National Marine Corp., 1819 Miami St., South Bend, Ind.



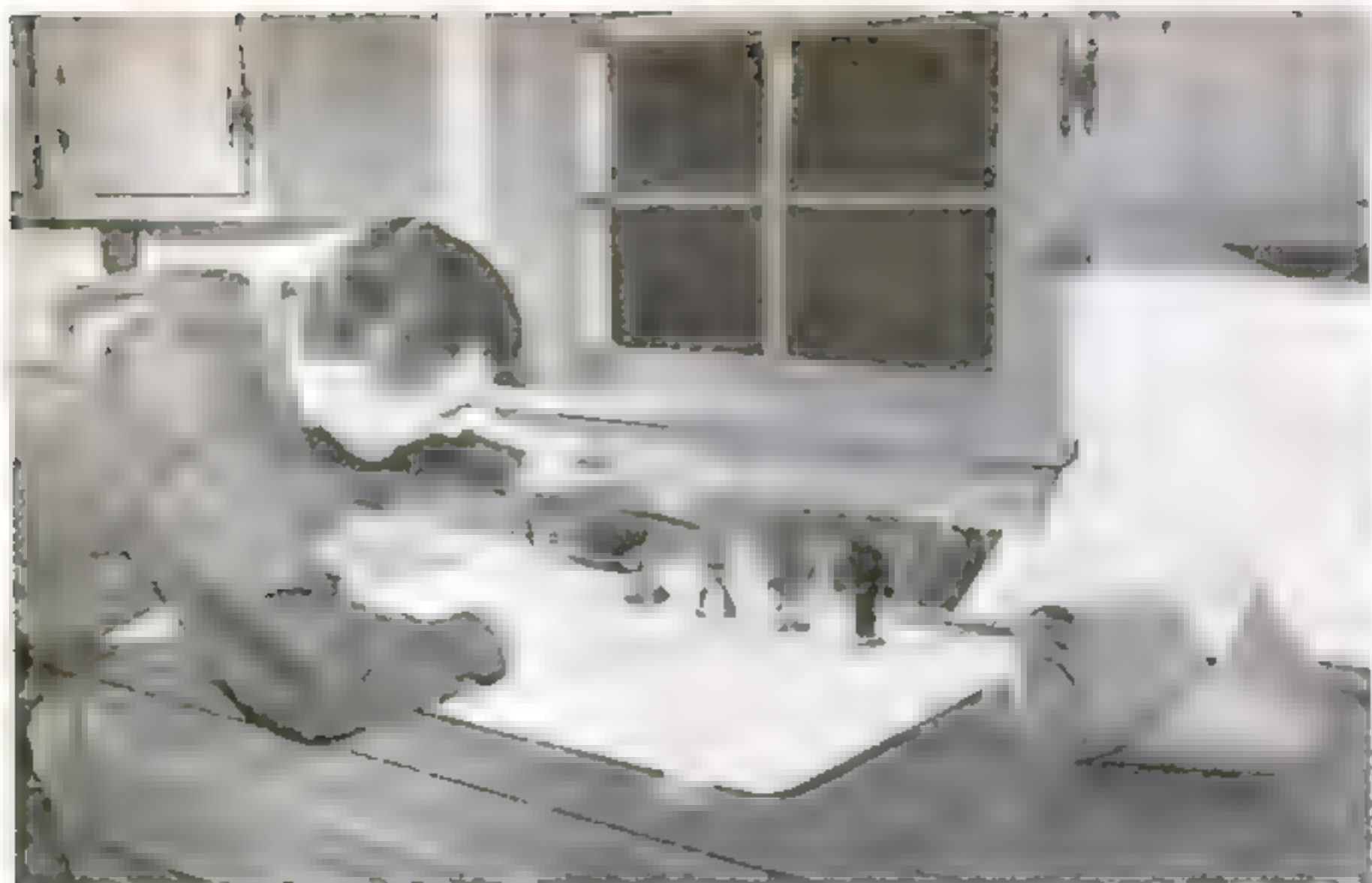
MAGNETO replaces coil and distributor to step up spark. Mini-Mag normally runs as a magneto, but an associated power pack converts it to battery ignition for starting. For car, truck, marine engines, \$125. Mal-lory Electric Corp., 12416 Cloverdale Ave., Detroit.



TURRET SPRAYER dials pattern you require: fan for walls, circular for furniture, fog for weeds or mothproofing. Self-contained gun works on house current, includes eight-foot cord. It sells for \$19.95. Burgess Vibrocrafter, Inc., Grayslake, Ill.



SPEEDOMETER is designed for water skis to record your speed on sharp turns and cuts that often double the rate of your tow-boat. Drill hole for its Pitot tube and fasten plastic case to one ski. Price, \$7.95. Nash Mfg. Co., 312 West Ripy, Fort Worth.



Adhesive Stainless-Steel Foil

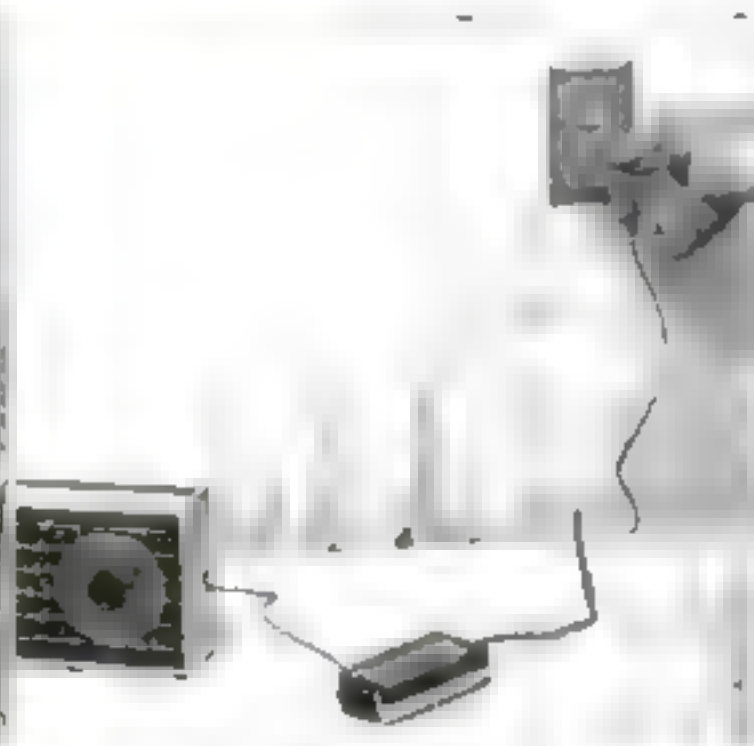
You can apply a sheet of this .003-inch-thick stainless steel to any clean, smooth, dry surface by hand pressure without use of tools. It can be used for decorative trim, splash guards, and

kick plates. Conforming to corners, curves, and molding, the material resists oil, alcohol, acids, alkalies, salt spray. Cost, 80 cents a square foot. Fasson Products, 250 Chester St., Painesville, Ohio.

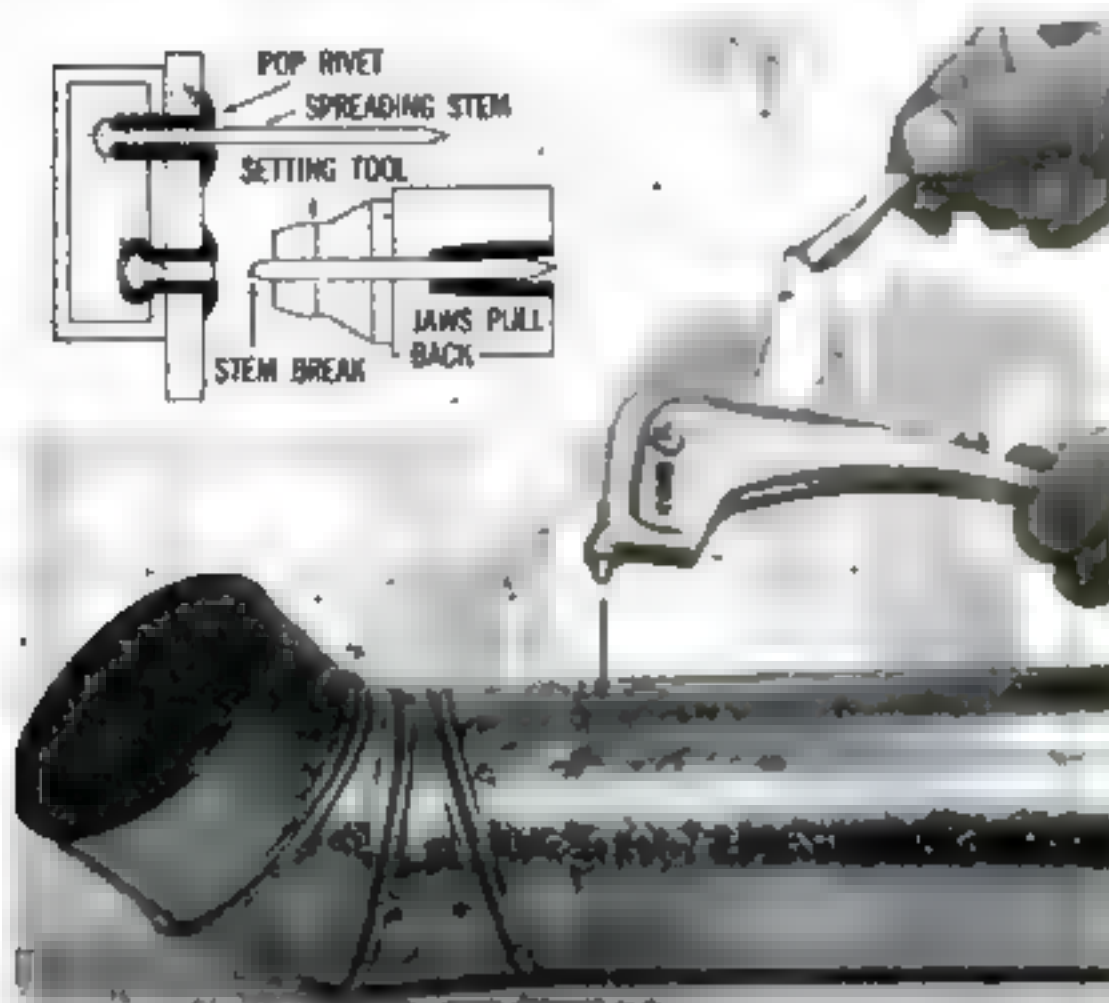
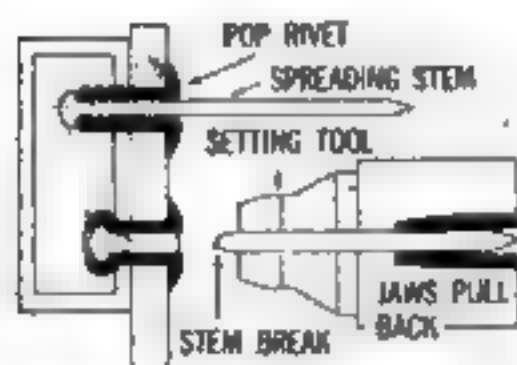


TWO-WAY LEVEL plumbs two surfaces at once, acts as facing straight-edge when you use it as a level on brick and similar jobs. Lok Level is made in three lengths: three and four feet at \$18, six feet at \$20. Lok Products Co., 1729 Hillside, Glendale, Calif.

CAR-TOTE drapes over back of front seat. It has a tissue dispenser, two see-through plastic compartments in front for maps, vacuum bottle, and other needs. Similar deep pocket in rear flap holds toys or beach gear. \$3.95. Daniel Low & Co., Salem, Mass.



RADIO BOOSTER gives you longer battery life for small transistor radios if you recharge shortly after each playing. Or, snapped on in place of the battery, it lets you play directly from house current. \$4. P. A. Brown, 54 Ruxton Rd., Great Neck, N. Y.



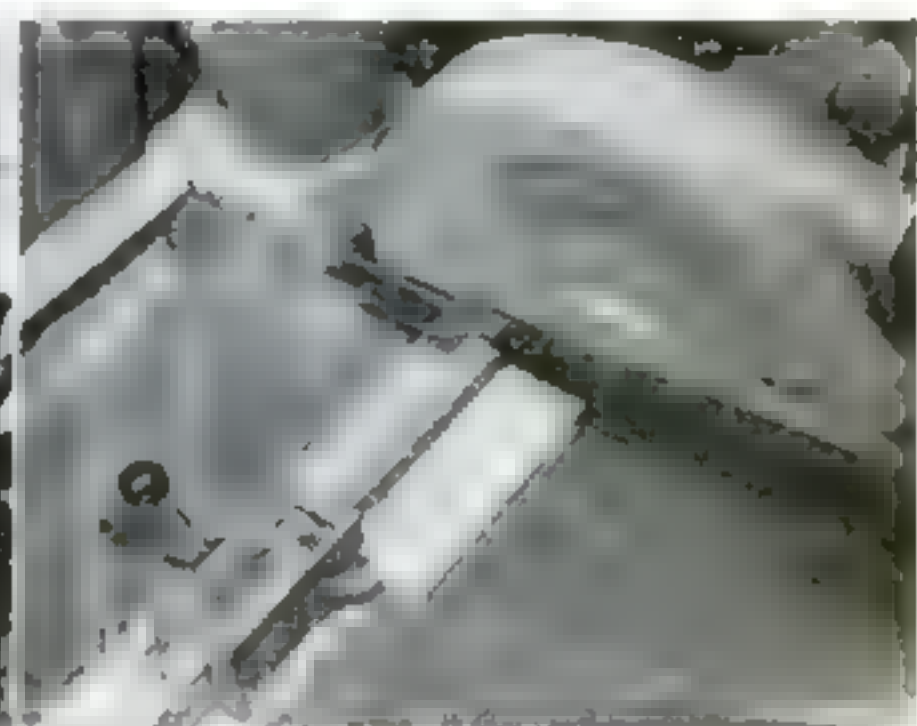
RIVETING TOOL fastens sheet metal when you can't get behind to back up a rivet. It uses a special rivet, pulling a headed stem through to spread the underside and popping the stem off on the inside. Setting tool and assortment of rivets, \$19.95. United Shoe Machinery Corp., 101 River Rd., Shelton, Conn.



CAR-INTERIOR SHAMPOO includes squeeze bottle and applicator with which you clean all materials in the interior: mohair, fiber, plastic, leather, rugs, and roof liner. Pressing releases foam through sponge and brush. Applicator and bottle cost \$3.98; refill, \$1.29. Bissell, Inc., Grand Rapids, Mich.



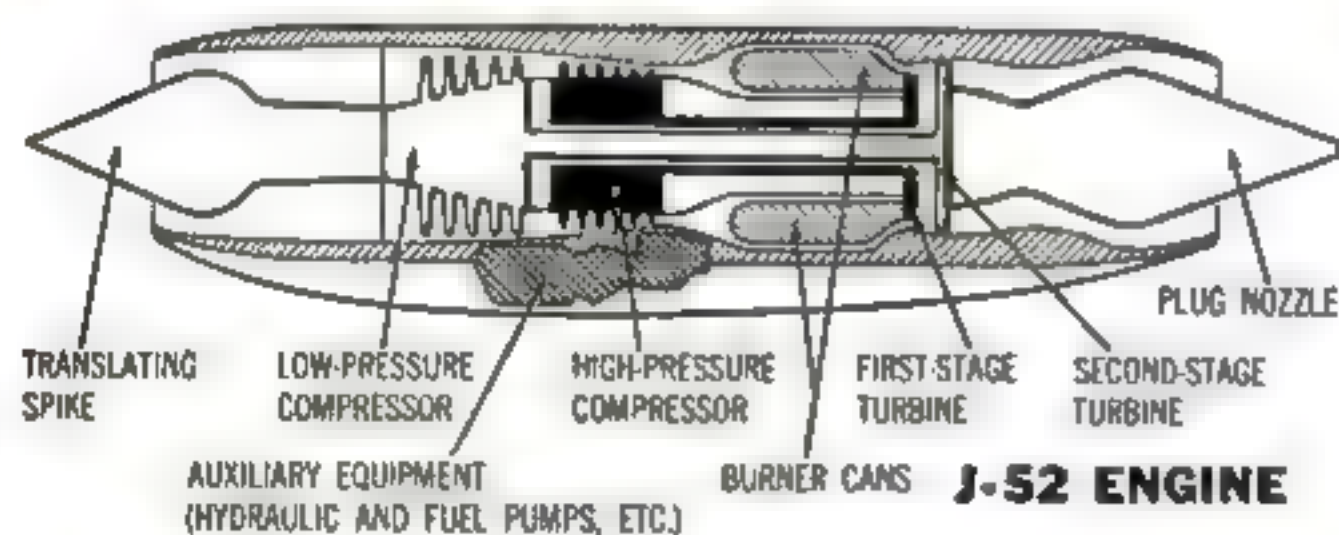
TOAST LIFT is shockproof frame that enables you to raise small pieces above the pop-up level of an automatic toaster so you can remove them without having to dig inside with a fork. It's useful for English and corn muffins, hamburger rolls, frozen waffles, slices of Italian and French bread. You can adjust it to fit any toaster. \$2.79. Bundy Sales Co., Mt. Tom Rd., Pawling, N.Y.



SAW STOP lets you cut duplicate parts to precise length with one setting. The aluminum casting fits over a tape recessed into top edge of any hardwood backstop 25/32 to 13/15 inch thick. Numbers are read through window with help of a pointer. Right- and left-hand versions for radial, swing, band, and table saws with miter-gauge groove. \$7.50. Rex Mfg., Box 253, Fontana, Calif.

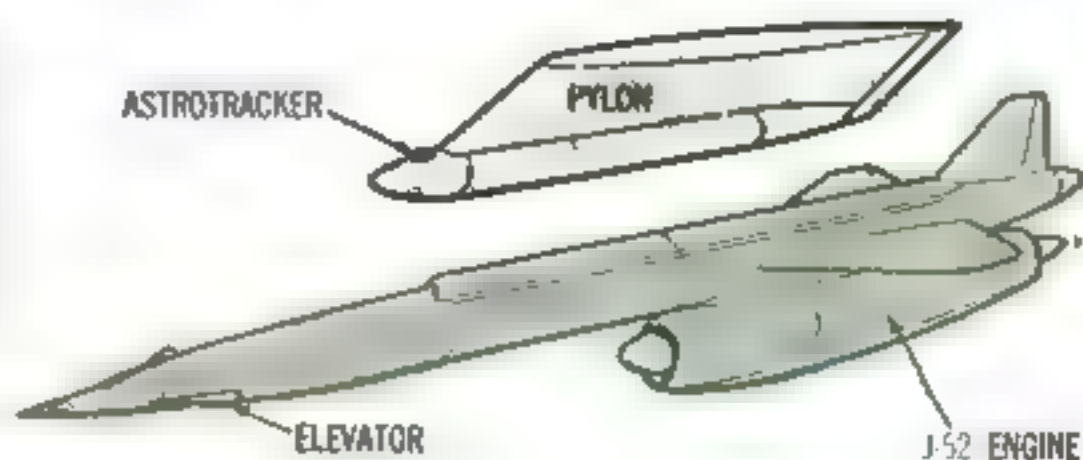


Hound Dog missile, snuggled under the wing of a B-52C, can be instructed on course and target



MISSILE'S JET ENGINE has a "translating" inlet spike that moves out automatically as speed increases, keeping sonic shock wave from entering inlet and choking off airflow. This movement also adapts inlet area to varying speed and altitude.

FLIGHT CONTROLS of missile are canard variety: Elevator is up front rather than at tail. They are operated by autonavigator built into missile body just aft of elevator. Bomber can launch missile from very high altitude or by slipping in low under enemy radar; missile itself can fly from hedge-clipper height on up. Pylon containing astro-tracker remains with the bomber after Hound Dog has been launched.



Hound Dog Streaks to Target Guided by Stars

By Tom Sherman

SLUNG under the huge wing of a B-52G is a pair of North American Hound Dog missiles. Straining like angry mastiffs at their leashes, they'll leap supersonically away from the "missile-platform" bomber if released. Racing hundreds of miles ahead, they'll blast gaping holes in an enemy's defenses.

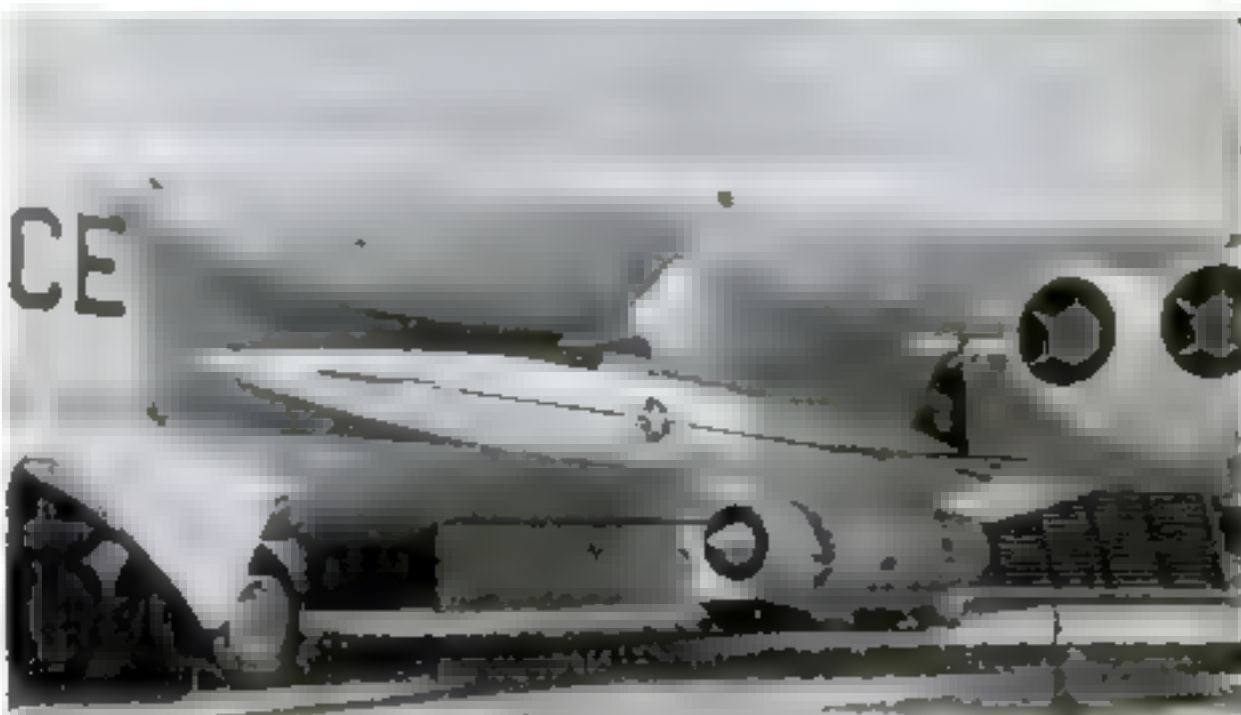
The 43-foot missile, officially known as the GAM-77, can deliver a nuclear warhead from a bomber to a target several hundred miles distant, finding its own way. The bomber crew need only tell the missile where it is, where the target is—and then launch it. Aiming is not necessary. It can feint at a phony target and then turn into the real one. An inertial autonavigator that can't be jammed or deceived steers it.

The missile's power plant, a 7,500-pound-thrust J-52 hung below the fuselage, is no ordinary jet engine. Operating at widely ranging speeds and altitudes, its intake must handle widely changing

up to the instant of launch.

AT SUBSONIC SPEED, translating spike, visible on under-slung engine, is retracted (right). Estimated cruising speed is more than $1\frac{1}{2}$ times the speed of sound. Range is said to be over 500 miles.

GROUND CLEARANCE of the Hound Dog is about two feet when mounted under the wing of a B-52G. Normally, the engine would act as a high-powered vacuum cleaner, sucking in damaging foreign objects. To avoid this, a jet of compressed air is squirted down in front of the intake to break up the suction vortex. Note also bulblike astrotracker in the front part of the pylon.



CONTINUED



SAM-77 AND ITS PYLON are shown on dolly for inspection and maintenance. The pylon is an integral part of the system, and is used by the missile until the instant of launch.

airflows and a sonic shock wave. An inlet "translating" spike moves in and out automatically, changing the intake area and positioning the shock wave.

Any long-range missile needs extremely accurate heading information. One degree of heading error gives you roughly one mile of lateral error for each 60 miles of range. They use laboratory-accurate transits to line up the birds at Cape Canaveral, but since this won't do in flight, the Hound Dog uses an automatic star tracker.

An astrotracker is built into the leading edge of the pylon that mates each missile to the B-52. The bomber-navigator picks a star to use and sets it into the system. Then the astrotracker locks on and measures the heading continuously. This heading data feeds into the autonav's computer, and the crew navigator sets in the exact geographical position for launch.

At launch, the missile separates from the pylon and is completely self-contained, its computer consulting accelerometers that measure any deviations from course. The computer continuously com-

pares where it is with where it ought to be and keeps the missile on course.

Keeping all this machinery working right is not easy. There are more than 16,000 components in the computer alone.

Practice test. But the Hound Dog can be dynamically tested without destroying it—without, in fact, its ever leaving its B-52. It just pretends. At the simulated launch point, instead of actual release, the missile's autonav takes over and steers plane and all to the would-be target.

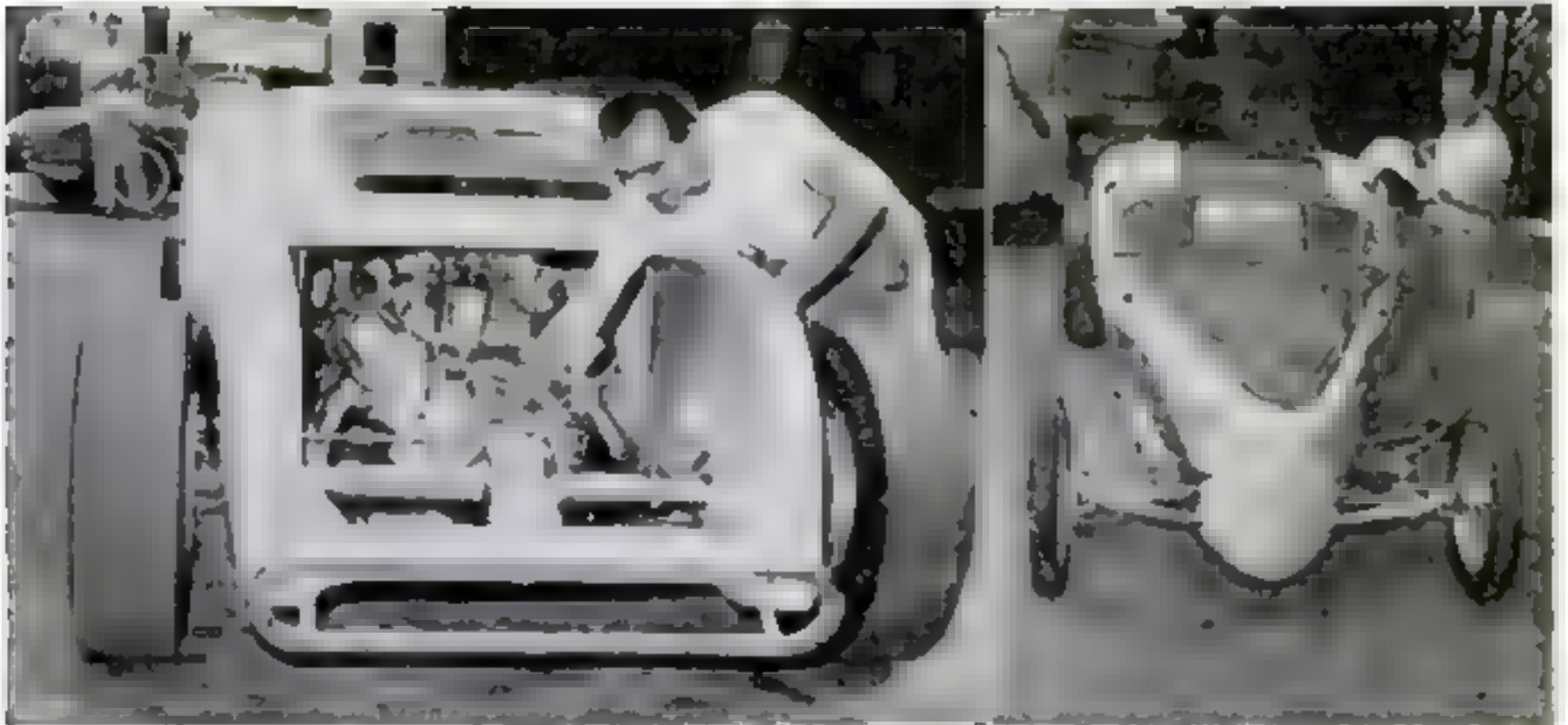
Then, instead of diving in, the missile announces, in effect, "The target is right down there." A radar check tells where it would have hit. If it missed, a test stand will make it tell what went wrong. Strategic Air Command crews must make at least six such runs yearly.

Now let's scramble aboard a B-52 that's been ordered on an attack mission. As the pilots fire up the 52's engines, the ground crew applies starting air to the Hound Dog's engines. At the co-pilot's right hand is a missile-engine control panel. He moves the engine-control knobs to the Ground Start position. In moments, the eight B-52 engines and the two Hound Dog engines are running.

Added power. With these extra engines, our takeoff roll will be a bit shorter. After takeoff, the co-pilot retards the missile engines to Maximum Continuous, where they'll stay until just before launch. During cruise, the 52's fuel system keeps the missile fuel tanks topped off at about 300 gallons. Now, as we approach the launch point, the co-pilot advances the missile engines to maximum power.

The navigator has both astrotrackers watching the sun or a star as he feeds heading data to the missiles. He sets in the altitudes he wants them to fly, checks the target coordinates, prepares the warheads, and refines the launch-position setting. We pass over the launch point. He lifts two red covers and depresses the launch switches. The Hound Dogs are on their way. Minutes later, they dive onto targets. Two enemy defense centers are demolished.

God willing, the Hound Dog, like the rest of the weapons in our A-arsenal, will never be launched in anger. But just in case—it's on the flight line now, ready to retaliate. ■ ■



CADILLAC ENGINE is in the rear, just as in a VW—but no VW's innards ever looked like this! Treadless rear tires give maximum traction.

LOWER-THAN-STOCK tubular front axle is chromed, as are the split, adjustable radius rods. Note lift-up doors with vent scoops.

Believe it or not: It's a Model A

There's nothing amateurish about this hot rod; it's the result of three years' work by George Barris, a professional body man from Lynwood, Calif.

Originally a 1931 Model A Ford, the coupe has been completely reshaped with sheet steel and aluminum. The top was chopped (sections cut out of the roof pil-

lars and windows trimmed down) and the body channeled (mounted lower on the chassis) to reduce air resistance.

The rear-mounted engine, including the block, is chrome plated. Fuel injection, a supercharger, stroked crankshaft, magneto, and racing camshaft add up to 500 hp. The car has topped 200 m.p.h.



Dummies for passengers

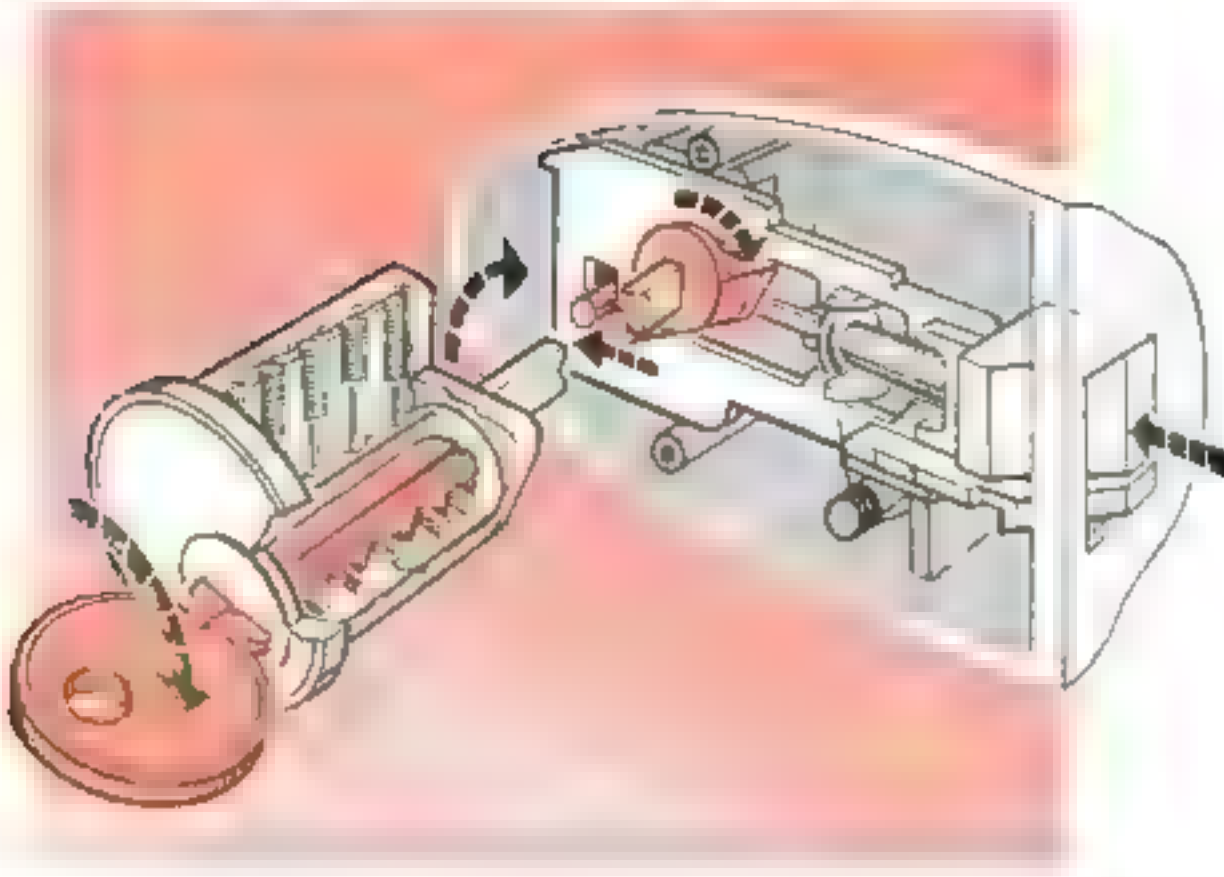
Iron blocks weighing 280 pounds each, about as much as two passengers, are used by London Transport to simulate service conditions while testing new subway cars and braking equipment. The blocks are grooved at center for easy handling by a forked dolly. Portable plates span the gap between station platform and cars.



Chaining up an oil fire

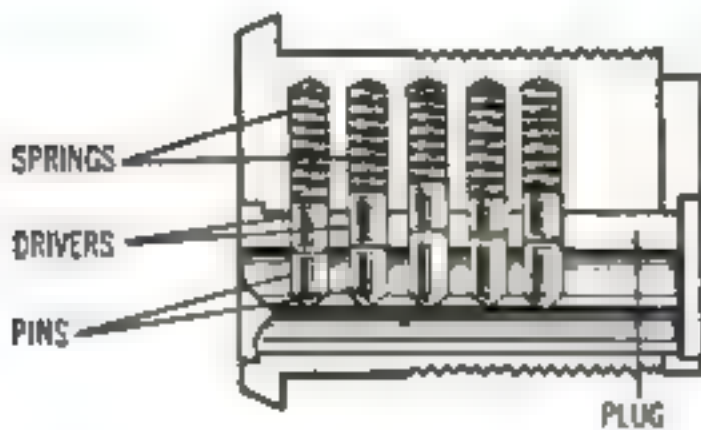
A floating barrier to protect ships and docks from fuel burning on the water is tested above on the Seine at the Paris port of Gennevilliers. It is made up of a series of buoys strung on a fire-resistant cloth rope. The fire is encircled by the chain, then towed away to a spot where it can do no damage.

How a Cylinder

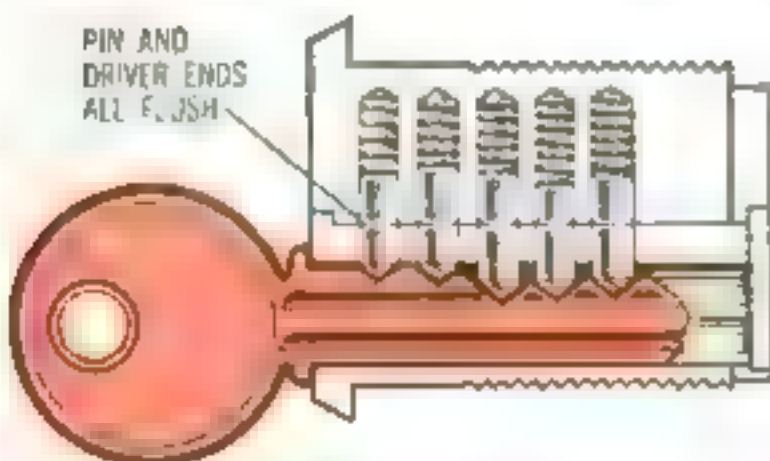


KEY PART of a pin-tumbler cylinder lock is a cylinder or case with an off-center hole. A plug slotted to receive the key turns in this. Drilled cross-wise in both cylinder and plug, and aligned when the key is out, are five small holes. Each contains a round-ended pin and a similar flat-ended driver. When they are in line (key is shown turned at left) the pins are pushed into the keyway by small springs. Inner end of the plug has a cam or a bar (as shown) engaging the second lock element—the bolt mechanism. When the key turns the plug within the cylinder, this cam or bar operates the mechanism, withdrawing the door bolt.

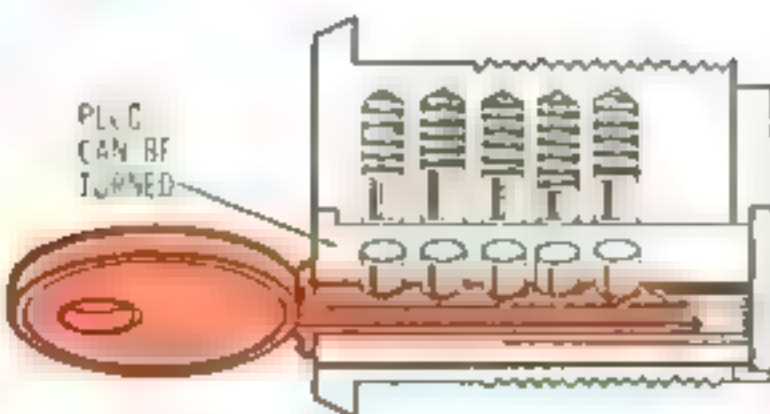
Plug cannot be turned until each pin is raised to an exact height



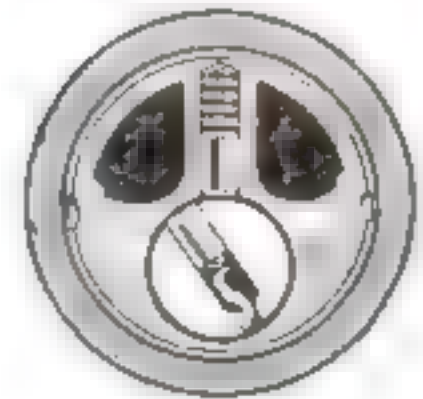
WITH KEY OUT, all pins are pushed against the lower keyway ridge. Partly in cylinder, partly in plug, the drivers keep plug from being turned, have greater shear strength than anything that can be inserted to force it.



AS KEY IS INSERTED, rounded pin ends ride over key bittings until each settles into its own notch, whose depth brings shear point between driver and pin exactly to surface of the plug. The right key aligns all five.



SHEAR POINTS ALIGNED, the key can turn the plug. A notch too low will leave a driver to bar the plug. One too high will raise a pin to do so. Thus a key having but one slightly wrong notch will not free the plug.



Lock Works

INVENTED by the Egyptians at least 4,000 years ago, the first pin-tumbler lock was not a cylinder type. It had a bolt secured by concealed wooden pins. A key with pegs spaced exactly like the pins raised them flush with the bolt, which could then be drawn.

For centuries, locksmiths exerted ingenuity in other directions. Some bolstered the security of poor locks with booby traps that cut off fingers, or trapped or shot would-be lock pickers. Others added fake keyholes, or built in dual or triple key movements.

In the 1860s Linus Yale Jr. patented improvements on a cylinder lock invented earlier by his father, a builder of bank locks. The resulting Yale cylinder lock

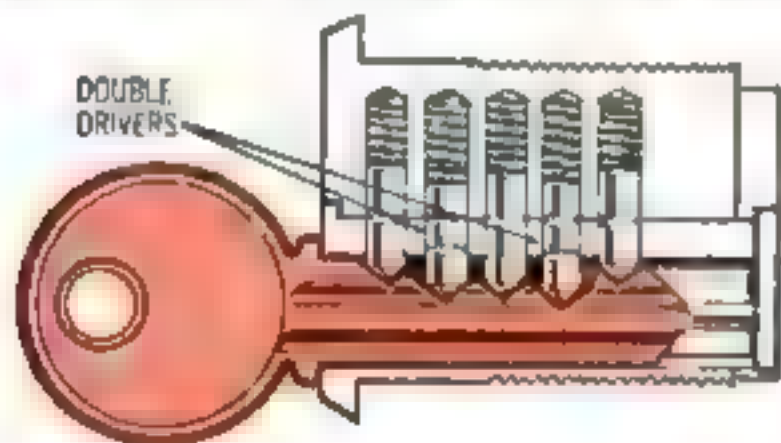
was the first mass-produced one to offer real security, plus master-keying.

Top example of this is the system devised by Yale & Towne for the United States Air Force Academy. Each cadet has a key that fits only his own locks. A sub-master key opens all locks in one dormitory corridor. Increasingly large groups of locks can be opened by master, grand-master, and great-grand-master keys.

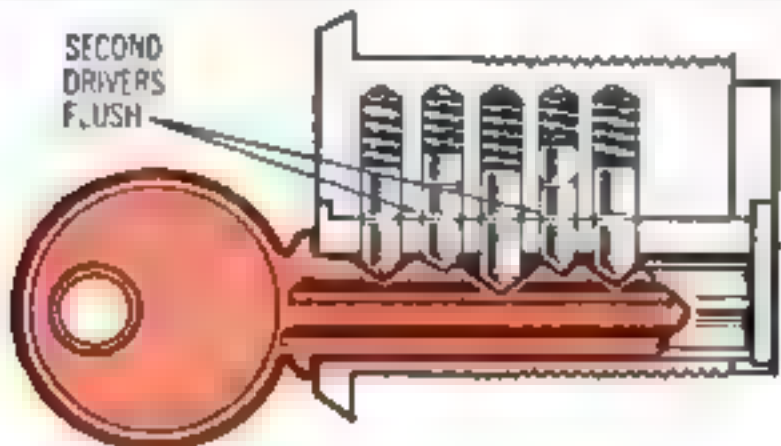
A closely guarded great great-grand-master key, available only to top-ranking officers, can open any of the thousands of locks used throughout the academy. Details of the system are secret, but the drawings below show the principle of master-keying.

Why a master key can open different locks

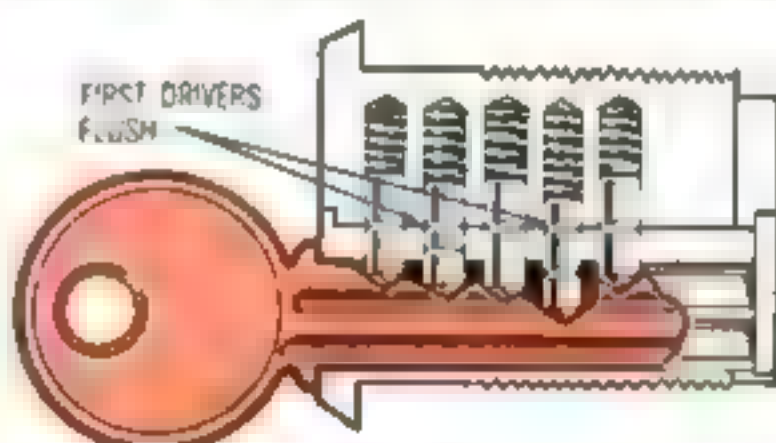
THE BIG DIFFERENCE between an ordinary pin-tumbler lock and one meant for master-keying is that some of the drivers are doubled. Below is a lock in which the second and fourth pins have two-part drivers. Mating bittings (notches) on individual key enable it to open this lock.



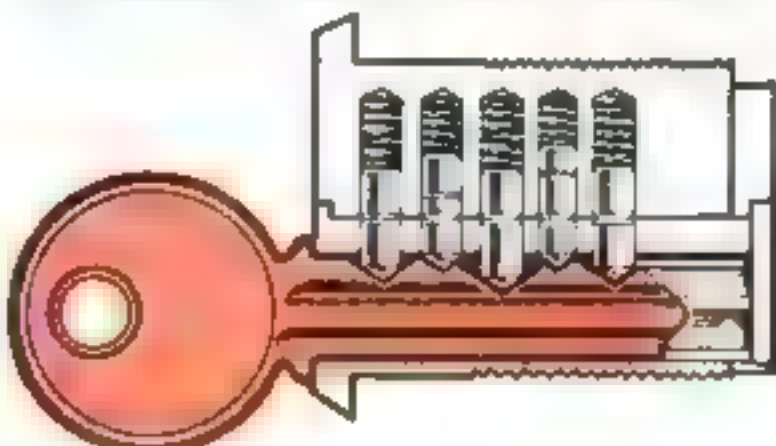
INDIVIDUAL KEYS for the two locks above both raise the two-part drivers only to their first shear points (see above). Below is a master key inserted in the first lock. Three of its bittings are the same as corresponding ones on the individual key. The two that lift the two-part drivers, however, are higher and raise them to the second shear points so the lock can be opened.

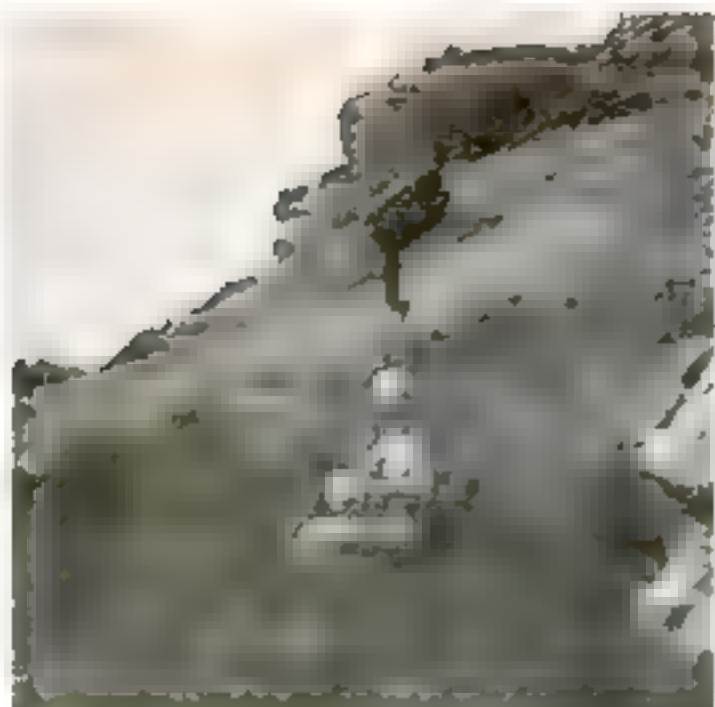


ANOTHER LOCK (below) has three pins identical with those of the one at left. But its second and fourth pins have slightly different doubled drivers. Thus each individual key will open only its own lock, for the key bittings that lift the drivers so the plug can turn are quite different.



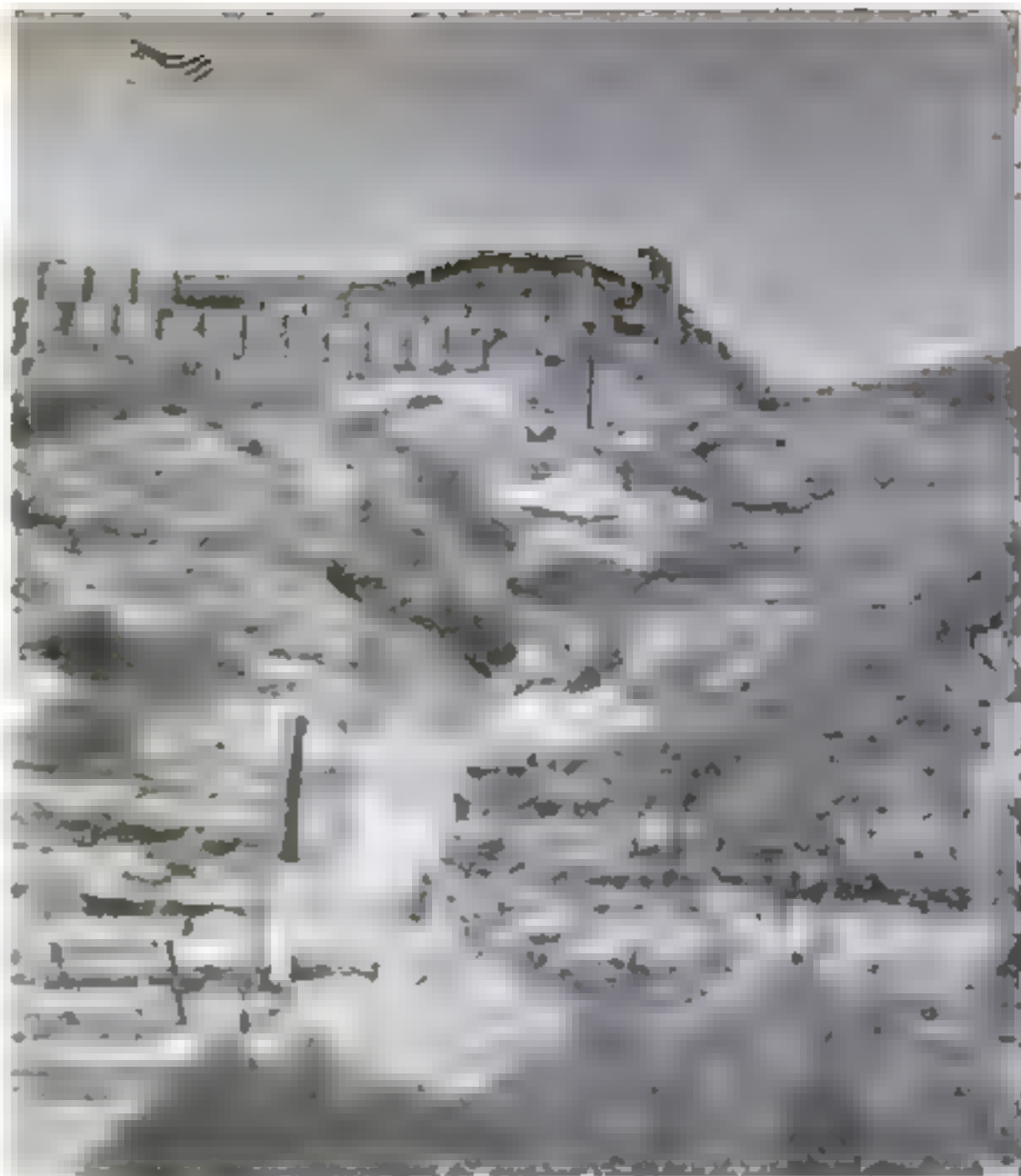
THE SAME MASTER KEY inserted in the second lock lifts its two-part drivers also to the second shear point, which is the same in both locks. A key that lifts one driver to its first shear point and the other to its second could be made for one lock, but would not open the other. Further master-keying possibilities might be achieved by doubling more than two of the drivers.





RIDING IN THE OPEN CHAIR with an abrupt 85-foot drop below is a thrilling experience. Chair and trolley are supported by 7/16-inch high-strength alloy messenger cable. A 3/4-inch aircraft cable pulls the trolley.

LOAD-CARRYING CABLE is anchored in the concrete foundation of the house and supported by three 4½-inch poles made of standard steel pipe. Upper and lower poles are set in concrete. Center pole is imbedded three feet in solid rock. The only source of trouble in more than a year has been corrosion of relay contacts in the salt mist.



Down to the Sea in a Cable Chair



SAFETY FEATURE on the chair's trolley is a spring-loaded cam. If the pulling cable were to snap (an unlikely possibility), the safety cam would automatically grip the load-carrying cable and prevent the chair from speeding down to the bottom of the bluff.

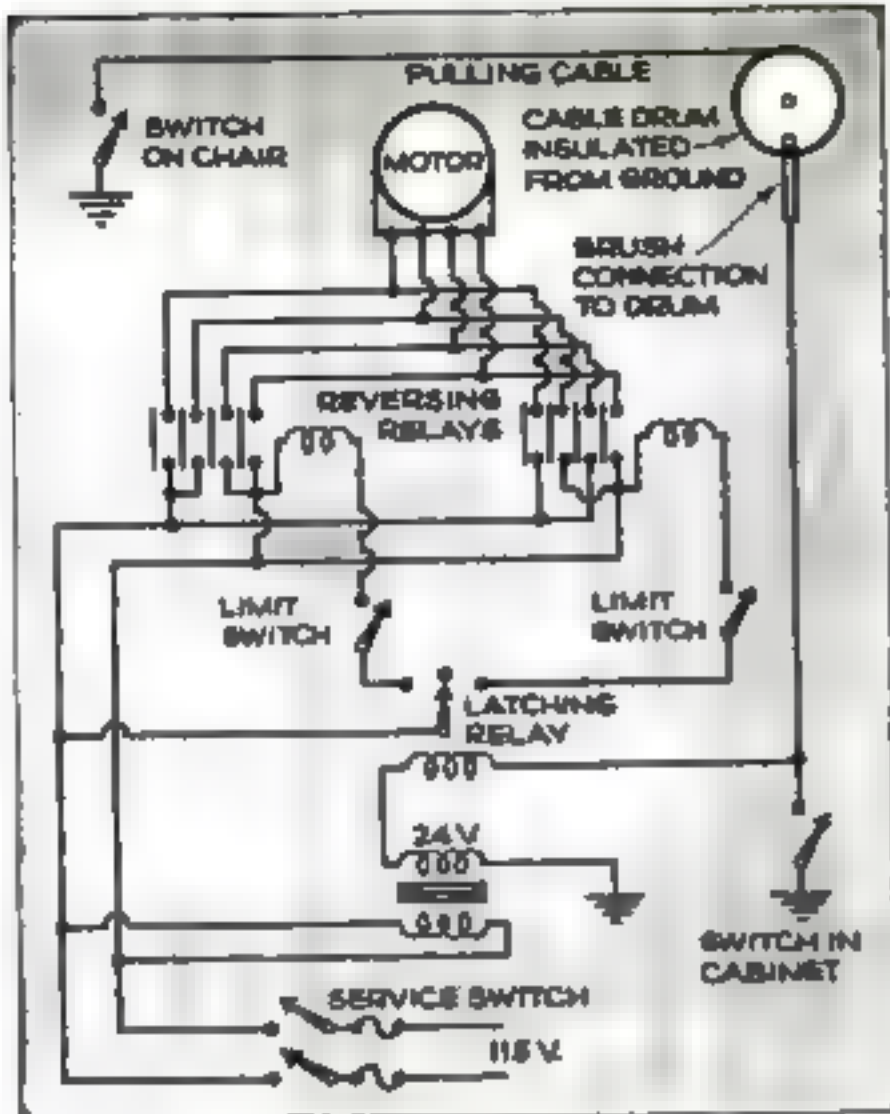
FIBER-GLASS CHAIR, originally a Beechcraft airplane bucket seat, has no retaining belt; the passenger's weight tilts it back safely. Control button is mounted shoulder high on support at right side of seat. A guard prevents accidental triggering.

A sprawling contemporary home in San Clemente, Calif. For a half mile in each direction an abrupt, craggy bluff. The open Pacific pounding at the shore far below. And the only way to get down to the beach a narrow, wind-swept path winding steeply down the bluff.

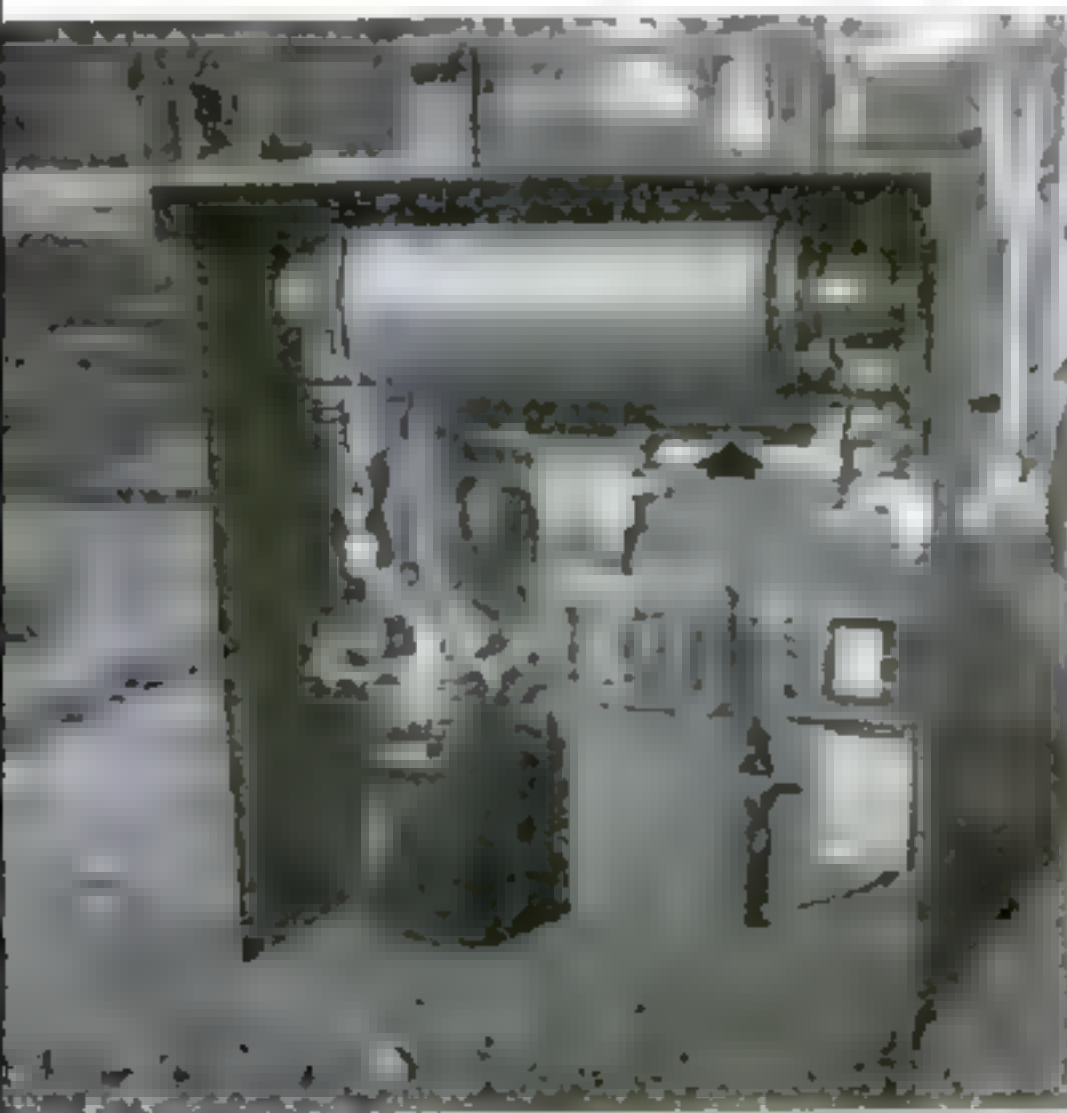
The owner of the cliff-top home, Miss Bernice Rhodes, likes sunbathing at the beach, but she doesn't particularly enjoy mountain-climbing. When she posed her problem to Douglas P. Davis, a consulting engineer from Burbank, he came up with a solution: an ingeniously designed cable lift for comfortable commuting to the beach and back.

An insulated drum for the pulling cable makes possible a remarkably simple and practical electrical circuit; besides the cables, no wires run from the power source to the chair, and a single passenger-operated button controls starting, stopping, and reversing.

The 135-foot cableway definitely doesn't fall into the small-budget category. It cost about \$5,000—or \$37 a foot.



LOW-VOLTAGE STEPPING-RELAY SYSTEM uses the pulling cable as the control wire (this is safe, since the wire carries only 24 volts) and the load-carrying cable as the ground line, to keep the wiring simple. Relays leading to the motor allow the rotation of the drum to be reversed.



SYSTEM IS POWERED by a $\frac{3}{4}$ -hp., 115-volt motor. A threaded rod (arrow) is connected by a roller chain to the cable drum and turns with it. When the cable is fully wound or fully unwound, a threaded block screwed along rod opens a limit switch and shuts off the motor.



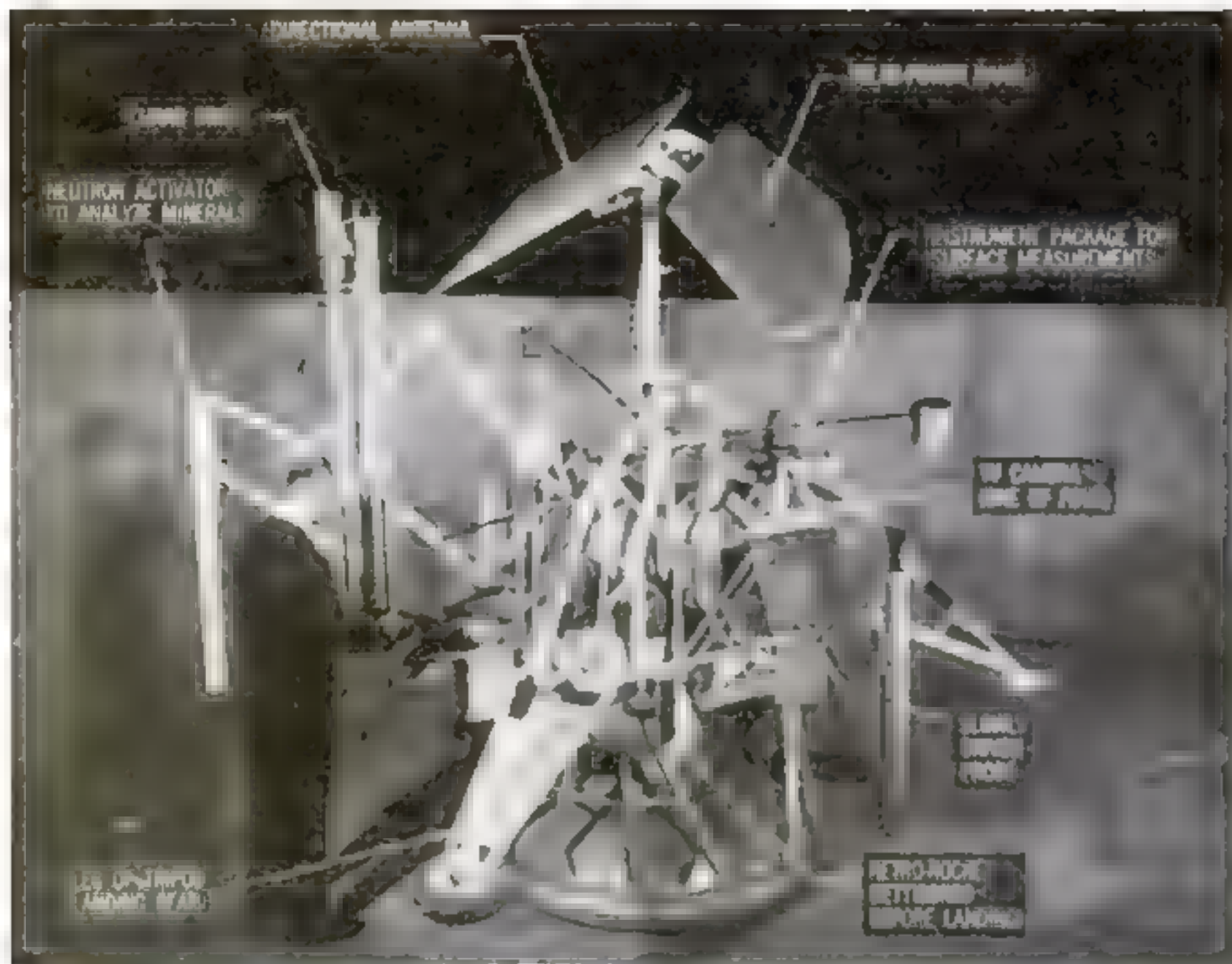
Four-bit trainer

These blinders for training pilots in all-weather flying were designed by William W. Roundy, an Ordnance chief warrant officer at Mannheim, West Germany. They cost him 50 cents: the price of two-hose clamps. Two discarded file-cabinet dividers and some paper fasteners made up the rest of his material. The hood can be folded flat and carried in a briefcase.



Sound deadener

Noise from a trio of pneumatic drills breaking up pavement in a London street is deflected from a nearby hospital by the plywood screen above. As the drillers move on with their work, the shield is lifted by a crane and replaced between them and the building.



Moon lab to solve lunar mysteries

This full-scale model gives a preview of Surveyor—an unmanned lunar laboratory. The U. S. plans to land seven of these on the moon between 1963 and 1965.

Hurled across space by an Atlas-Centaur rocket vehicle, and slowed to six m.p.h. by a retro-rocket and smaller vernier rockets as it approaches the moon's surface, Surveyor will touch down gently on its tripod landing gear. Then 200 pounds of scientific instruments will go into action.

TV cameras, looking into rotating mir-

rors, will view the lunar landscape in all directions and transmit the pictures to earth. Fingerlike, a descending probe will "feel" the surface dust or rock. Boring downward, a drill will collect samples for automatic analysis, from a depth of 18 to 60 inches. A seismometer will register moonquakes and meteoric impacts. Other instruments will measure the moon's temperature, radioactivity, magnetic field, and any traces of an atmosphere. Each Surveyor's observations will continue for about a month.

Steel overcoat protects radar

Typhoons can no longer threaten damage to delicate tracking antennas at the Army's Nike anti-aircraft missile sites on Okinawa.

A steel shell fitted over each radome can be closed in 90 seconds at the approach of a storm, and opened again to keep from blocking out beams when the radar goes back into use.



DOUBLE-LENGTH
FEATURE OF
TRUE SCIENCE
ADVENTURE

THE DARING VOYAGE OF A SECRET SUBMARINE
A TRUE STORY OF THE FIRST SUBMARINE TO CROSS THE PACIFIC OCEAN
FROM HONOLULU TO SAN FRANCISCO IN 1901

The Daring Voyage of a Secret Submarine

BY ROBERT L. FORT AND GEORGE F. FORT

DOUBLE-LENGTH
FEATURE OF
TRUE SCIENCE
ADVENTURE

EIGHT years ago this month, a fantastic ship completed one of the most remarkable voyages the world has ever seen. An atomic submarine made landfall at Fastnet, off the southwest tip of Ireland. It had steamed nearly 3,000 miles from Nova Scotia at full power, without stopping, without surfacing.

The repercussions of this unique and daring trip continue to echo today, and will for many years to come. It influences such commonplace things as the way power for your lights and toaster is generated. On it hangs the fate of nations in this first decade of the hydrogen-tipped missile.

By any standard the voyage was remarkable. No submarine had ever before covered more than 20 miles under water at full power. Even surface warships are not expected to hold full power longer than four hours; this trip took more than 100 hours.

Yet most astonishing of all is this fact: The transatlantic crossing—painfully real and frighteningly dangerous to a few dedicated men—was imaginary.

The submarine was the Nautilus Mark I, containing the first power-producing atomic engine ever built anywhere. It

never moved an inch, for it was submerged in McGaraghan's Sea, a 38-foot-deep tank inside a plain concrete hangar. It churned its big prop shaft in a power-absorbing water brake built on the sagebrush flats of southeastern Idaho, which is about as far from the ocean as you can get in North America.

The trip under the Atlantic was only a paper cruise—an inspired stunt ordered on impulse by a cantankerous and fanatical Navy captain. His men stuck up navigation charts in their authentic submarine control room. They ran the atomic engine flat out. At the end of each watch, they marked off the position they would have reached. Despite groans from partly shorted generators, screaming whines from a faulty pump, the fearful hiss as condenser tubes burst, they

kept the throttle open until the position mark could be made at Ireland.

Almost anything could have gone disastrously wrong. This was the first, the only atomic engine. It had logged little more than 24 hours full-power operation. Now it was to be run continuously five, six times that long. What might happen? Easily all 315,000 gallons of McGaraghan's Sea might boil over with radioactivity. A bomblike explosion was impossible (at least that's what it said in the book).

Only Captain Hyman George Rickover—a bur under Navy tails these many years—would have dared risk his career, \$30,000,000 in Government equipment, even the safety of subordinates on such a gamble. He dared because the prize was great.

The technical details of the simulated voyage are still locked inside the Navy's secret files—the hour-by-hour log, for instance, cannot yet be released. But fragments of the



First atomic engine ever built anywhere, STR (Submarine Thermal Reactor) Mark I still steams along quietly inside this windowless hangar at National Reactor Testing Station. It's in the Idaho desert, about as far from the ocean as you can get.

story, made public here and there, can now be assembled to reveal for the first time the broad sweep of a modern epic. It is an exciting adventure story of science, the drama of brave men pressing a dangerous venture into the unknown.

THE scene was a vast Idaho wasteland marked to the north by twin, bare peaks (which were promptly christened the Jane Russell Mountains). You can see for two weeks in every direction. Only antelope and goats live there.

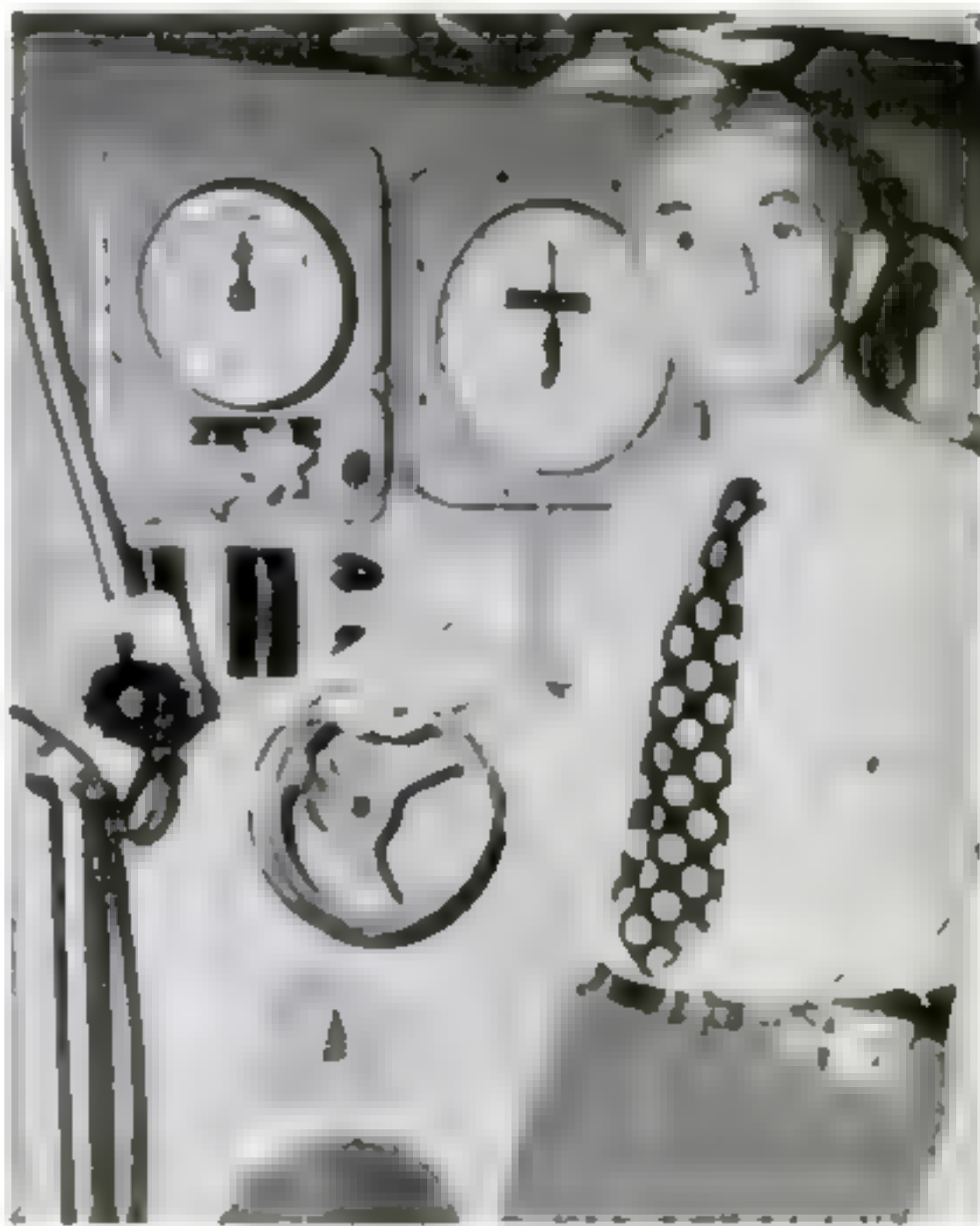
But the air was bracingly crisp in the Idaho spring, the sky clear blue. A white plume of steam capped the concrete hangar—a big, plain structure ("Don't build a monument in the desert," Rickover had warned).

Inside, the plant was all Navy. It looked like a ship, gray and white. It smelled like a ship, that nautical mixture of fresh paint, hot oil, and the faint aroma of overcooked coffee.

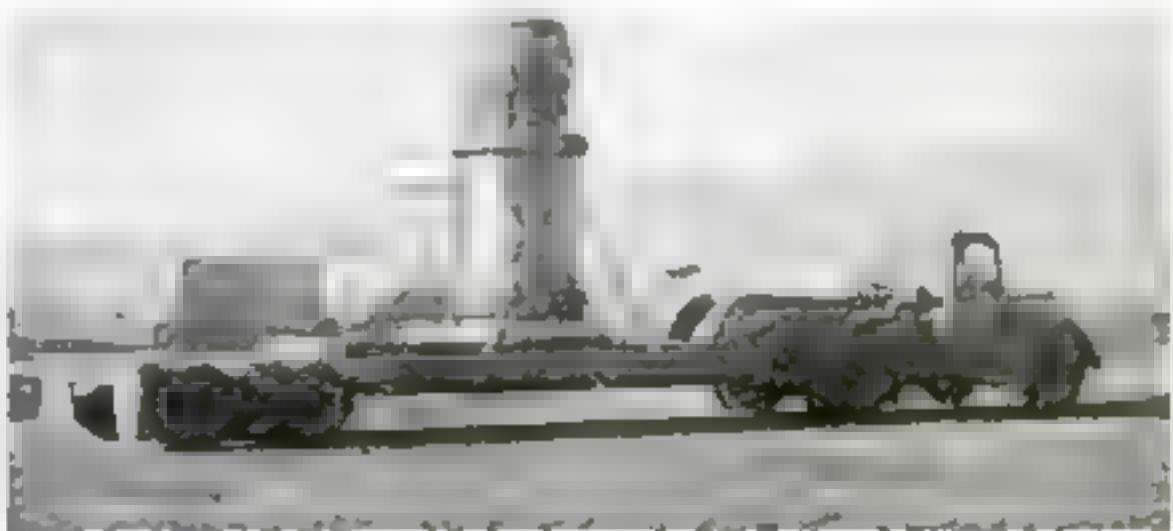
The men were young, bright, casual, and very busy. Shirt sleeves were the uniform of the day, neckties a formality reserved for visiting admirals. (Once an admiral inadvertently lunched with the enlisted men; he thought they were civilian physicists.)

Amidst this activity sat McGaraghan's Sea, named after the Navy construction boss, Commander J. J. McGaraghan. Half in, half out the sea was the atomic submarine Nautilus Mark I. No mockup, it was an exact working duplicate of the major part of the seagoing Mark II, which was even then being assembled at Groton, Conn., 2,500 miles away (this was another of Rickover's blue-chip gambles, but we'll come back to that later).

Sealed and armor-plated, uranium-crammed core for experimental Mark I atomic engine was secretly shipped from Pittsburgh to Idaho in 1952. Truck carried core to special freight train—all cars empty except the one with the core—which never exceeded 20 m.p.h.



Hand on the throttle (it's a real sub throttle). Rickover gets the feel of atomic power the day Mark I engine is first started up.



**DOUBLE-LENGTH
FEATURE OF
TRUE SCIENCE
ADVENTURE**



The landlocked sub: stern in foreground, then long engine room, with atomic boiler in tank behind.

The heart of the Mark I engine—its uranium-crammed core—had reached Idaho in late 1952 inside a railroad box-car. It was a strange train ride that, for elaborate planning and finicky attention to detail, typified the whole project.

The tanklike core, loaded with precisely machined rods of such exotic metals as hafnium and zirconium-uranium, was precious and dangerous cargo. Could a collision en route start atoms splitting? Was explosion possible? This was a new breed of machine. Nobody had ever shipped one before. So it was first vacuum-packed, like coffee, inside a capsule. Then the capsule was enclosed in thick armor plate.

The core rode a special train—all box-cars except one were empty, and only insiders knew which was That One. The train never went over 20 m.p.h. all the way from Pittsburgh to Idaho Falls. It carried its own force of guards and safety experts. And a flying wedge of patrol cars, like destroyers screening a battleship, wheeled along highways paralleling the tracks. They were in constant radio contact with the train, ready to

close in if saboteurs attacked or there was an accident.

Mark I's atomic furnace went critical—was kindled—at 11:17 p.m. March 30, 1953. Two months later the engine was finally turned on with a modest display of hoopla. Rickover flew in with Thomas E. Murray, the tall, courtly New York engineer who was then a member of the U. S. Atomic Energy Commission, and Murray turned the valve. All hands toasted the historic event in soda pop spiked with dollops of chem-lab ethyl alcohol.

Then followed weeks of precise, cautious tests as output of the compact but powerful atomic engine was gingerly increased. Nobody knew whether something disastrous might happen. Nothing did.

One by one, unneeded safety circuits were disconnected. At the beginning they had been so sensitive that the reactor scrambled—zinged its hafnium control rods in for emergency shutdown—every time a crewman clumped past, or lightning struck a power line in Montana, hundreds of

miles away. The caution was understandable; nothing like this power plant had ever been operated before.

ON JUNE 25 full design power (many thousands of horsepower) was reached. The engineers began a 48-hour full-power run. They needed some important data on the physics of a high-power atomic furnace. All went smoothly. After 24 hours they completed their measure-



Lake in the desert is 2,000,000-gallon spray pond that cools water for steam condenser and power absorber

ments and were ready to shut down the plant. Little did they know.

Rickover—a toothbrush in-the-briefcase type who dropped in frequently and unannounced—happened to be at the site that day, and learned of the plan to shut down.

He had other ideas.

The Old Man, delighted that the 24-hour test had come off so well, resolved to continue it: full power hour after hour after hour for a simulated cruise from Nova Scotia to Ireland. He needed dramatic proof that an atomic submarine could cross the ocean under water *at top speed*. A feat like this would revolutionize naval strategy. Then nobody could dare block the Nautilus program, which he had crammed down the throat of a hostilely skeptical Navy.

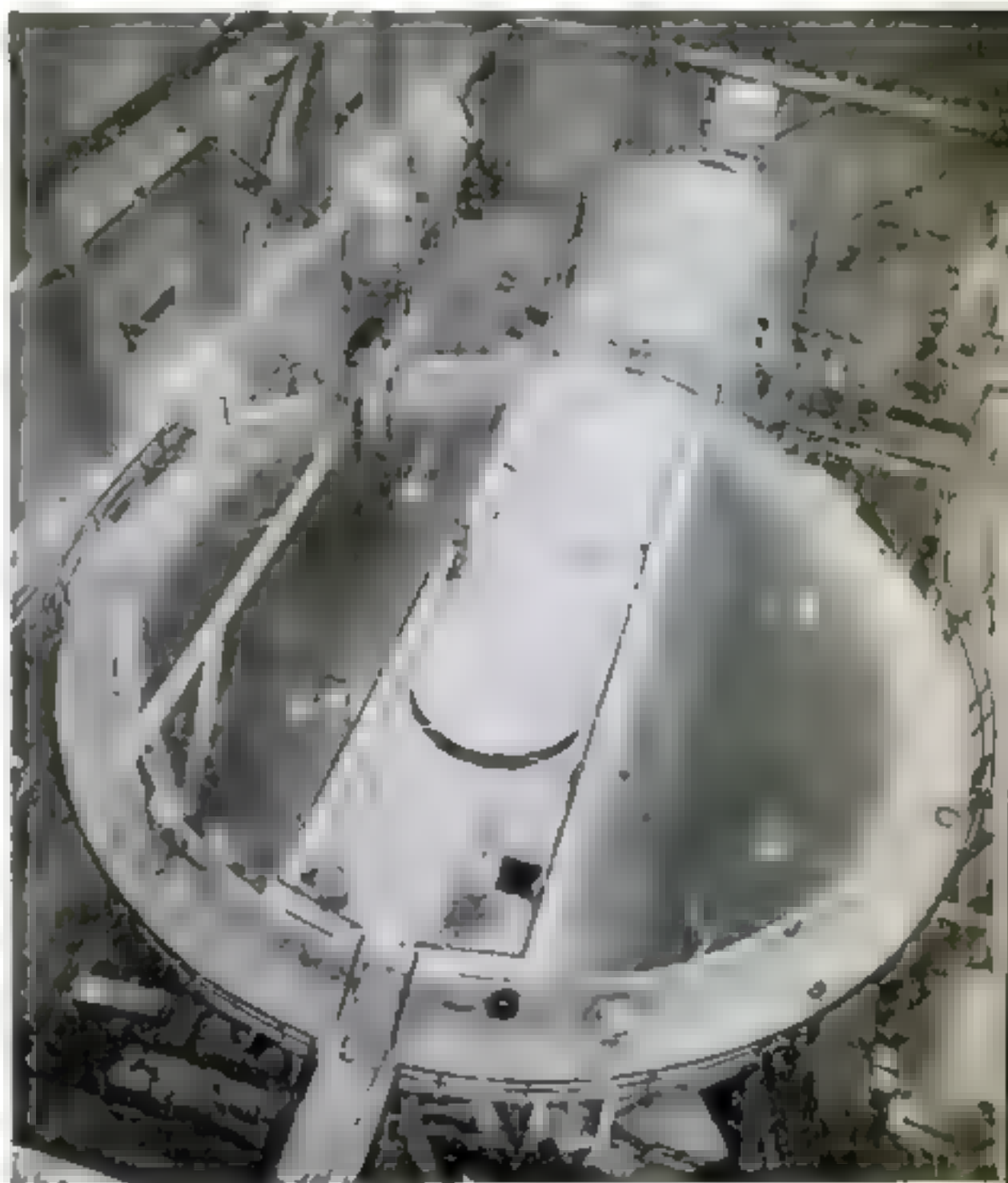
Rickover knew his assistants would scream. They did. There was quite a row, as you can sense by reading between the lines of Lt. Cmdr. E. E. Kintner's laconic description. Kintner, then and now one of Rickover's boys, said:

"I was the senior naval officer at the site. I felt that extension of the run was unwise considering the many uncertainties, and told Rickover that beyond 48 hours I could not accept responsibility . . . Rickover directed me to proceed with the simulated voyage."

The charts went up in the control room and a great-circle route to Ireland was plotted. The select crew (half of the enlisted men later became commissioned officers) stood regular four-hour watches. Tension mounted despite the reassuring monotone of the turbine. Each watch tried to outdo the others, pushing that mark on the map slowly, inexorably toward Europe.

The end of the second day out brought only grins of admiration. "She just sits there and cooks," said a crewman. A veteran engineer, thinking of the tank loads of oil an ordinary sub would have burned, pointed with awe to the propeller shaft: "So much comes out back here, and nothing goes in up there!"

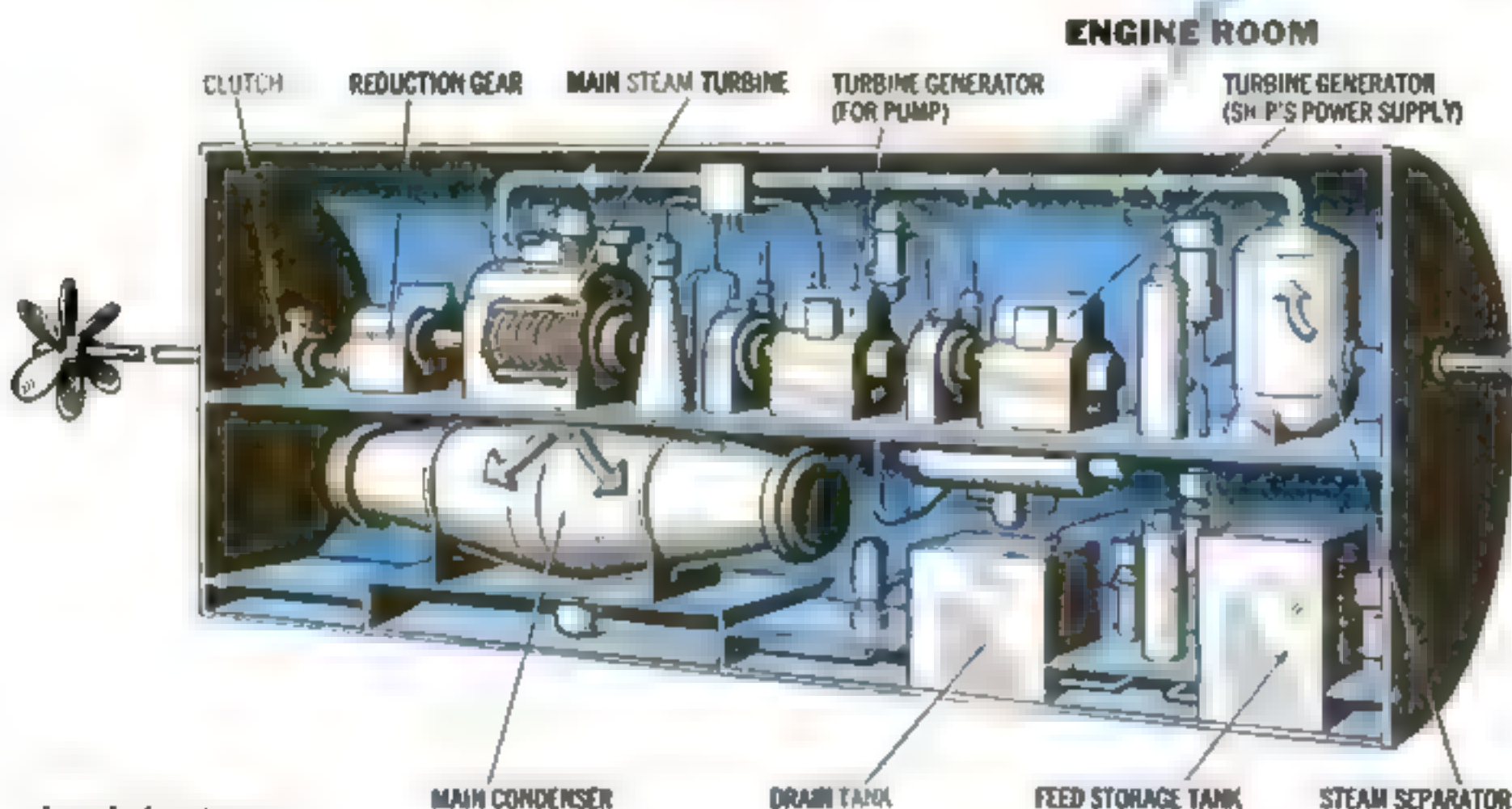
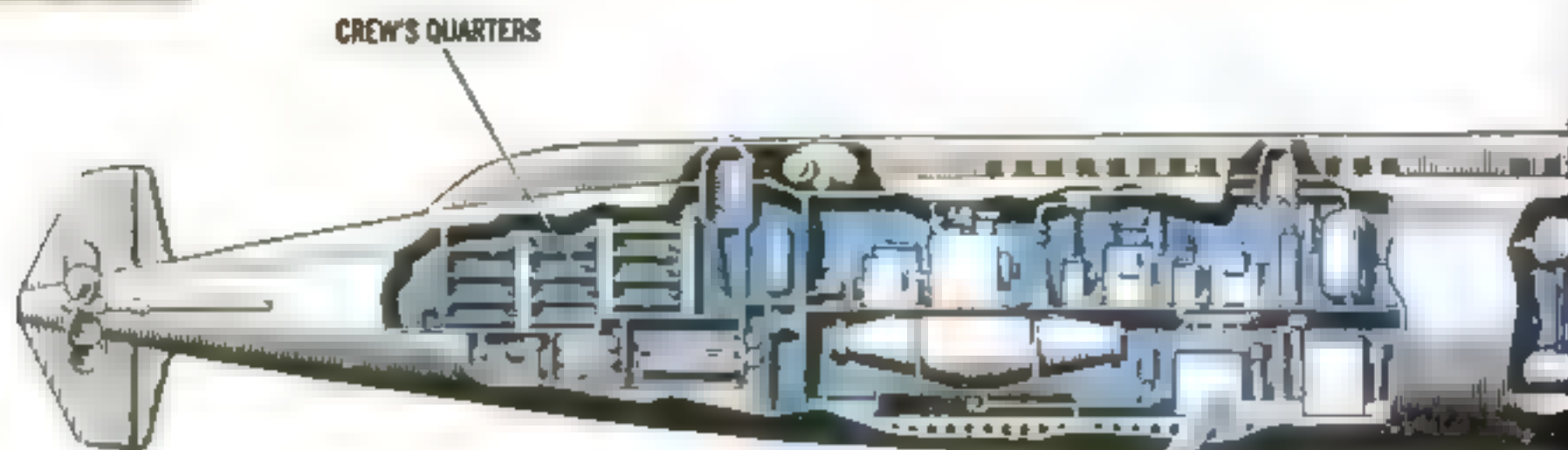
It looked at this point as if Rickover had once again drawn aces. The transatlantic cruise was a hazardous gamble, but only the last and most dramatic of a whole series of risky short cuts that crashed the atomic submarine past official obstruction and into the fleet. Rickover was not only willing to take chances—he insisted on it.



McGaraghan's Sea—38-foot tank—holds experimental atomic engine. It was put under water, like real sub, to find out if ocean water would reflect rays back to injure crew.

**DOUBLE-LENGTH
FEATURE OF
TRUE SCIENCE
ADVENTURE**

No compromises were allowed for experimental model of atomic sub. Reactor, turbine, and controls exactly duplicated seagoing vessel's (cutaway below).

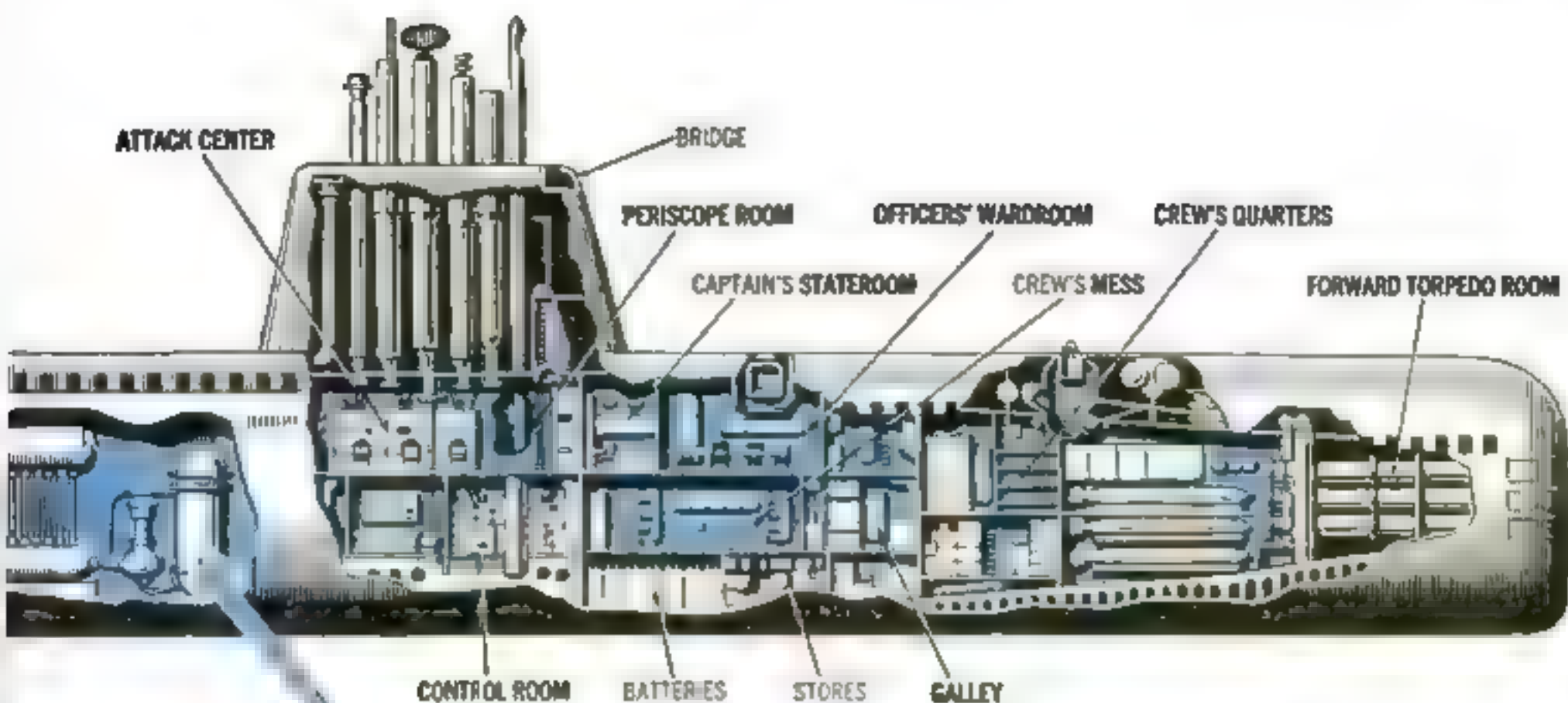


A-sub is steam-propelled, adding complications that diesel-electrics avoid. Steam turbine turns propeller through reduction gear. Seagoing Nautilus has twin turbines and screws (one shown above).

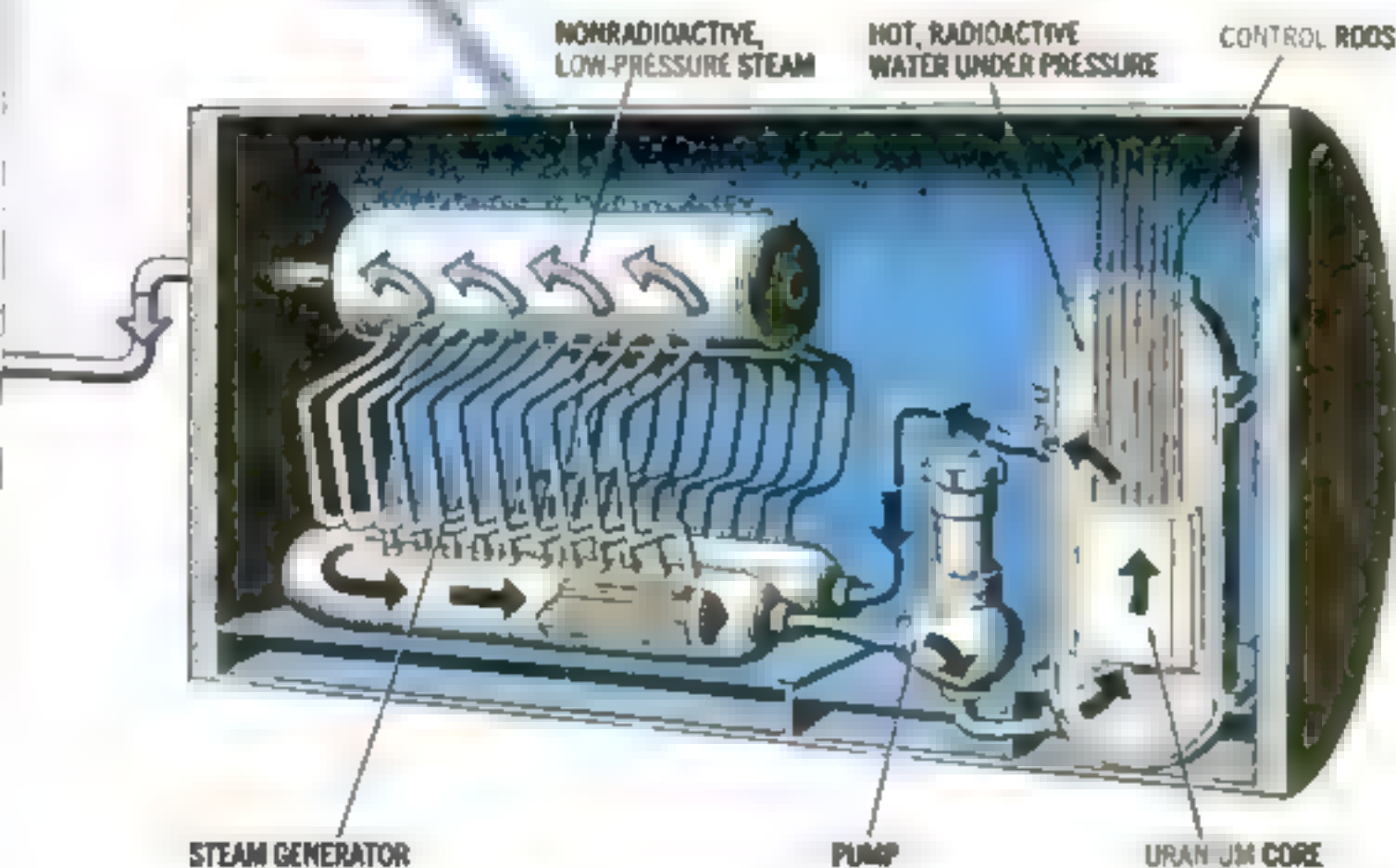
SEVEN years before, Rickover had been ordered to the AEC's Oak Ridge laboratory. He was to study the strange new science of atomic energy for possible naval applications, following up on seemingly wild ideas of a few Manhattan Project men. The armed services often make this kind of liaison assignment, usually nothing comes out of it except fat reports for the files.

It's hard now to remember how little was known in 1946. Atomic energy had been put to work exactly twice, to blow up Hiroshima and Nagasaki. There was some talk about the possibility of atomic-fueled electric generating stations. But even optimistic scientists guessed that it would take at least 25 years to build the first one. And it would be a gigantic plant encased in massive concrete. The idea of putting an atomic engine inside a submarine was preposterous.

Not to Rickover. He returned to the Pentagon fired by the strategic value of atomic submarines. He began a furious crusade to get them for the United States, and to get them



REACTOR



Pressurized Water Reactor, pioneered in Nautilus, is now widely used. Splitting atoms in its core heats water, which is under pressure to prevent boiling. Hot, radioactive water transfers heat—but not radioactivity—to secondary water supply, making steam for turbines. Sketch shows typical PWR, not actual Nautilus reactor, which is still secret.

ahead of any other nation. Driven by a sense of urgency that few people shared, contemptuous of protocol, red tape, politeness, and little minds, he fought a lonely battle. He won a handful of devoted followers (some very powerful) and made many enemies (also powerful).

To save time, he evolved a daring plan that appalled his associates. This was the first of his short cuts, and the riskiest.

Any reasonable engineer would have started with a breadboard—an atomic engine spread out laboratory-fashion so that every part would be easy to install and replace. Once the bugs were out, the breadboard engine would be redesigned to fit a ship—a surface ship offering plenty of elbow room. If it worked there, then, finally, it would be redesigned to fit a submarine.

Rickover would have none of this. Despite bitter arguments from his staff, he insisted that the Mark I atomic engine was to be a *submarine* engine, inside a real submarine.

Practically simultaneously, a seagoing Mark II was to be constructed.

Every time someone tried to duck a submarine problem in order to simplify an atomic problem, Rickover snapped: "Mark I equals Mark II."

For example: A submarine hull—and every piece of machinery inside the hull that is in contact with sea water—must withstand pressures totaling hundreds of thousands of tons. Mark I and all its components could. (Among the oddest of these components was the safety valve. Unlike ordinary diesel-electric submarines, A-subs are steam-driven. They need specially designed safety valves that can let off steam under water.)

Submarines must be air-conditioned, for no wind blows through to carry engine heat away. Rickover insisted that Mark I, in the cool Idaho uplands, have air-conditioning. And he demanded three times the cooling capacity that his engineers considered adequate. (He was right; the seagoing Mark II Nautilus couldn't operate without its extra air-conditioning capacity.)

Submarines must fight through the blasting jolts of depth-charge attack. Mark I met postwar Navy standards—and then some.

To make sure of that, Rickover wangled space for some of his equipment aboard the Ulua, a surplus sub that was sunk in Chesapeake Bay, blasted with real depth charges, then hauled up. The results ignited Rickover, whose temper is legendary. In full blaze he showed suppliers what had happened to their "shockproof" machines, and demanded great and immediate improvement.

The Old Man's cranky perfectionism was hard to live with, but it also inspired the men working on the project. They commuted to work from the nearest town: 83 road miles each way. When a particularly awkward welding job came up, two men volunteered to try it wearing only goggles, no masks. Their faces were so badly burned by molten metal that they spent a week in the hospital.

*A great gamble won:
SSN 571, the
seagoing Mark II
Nautilus, under way
on atomic power.*

*This vessel
revolutionized naval
warfare, for it was
the first true
submarine, able to
stay under water
indefinitely and
travel under water
any distance.*

*It was well along
in construction
before anyone knew
whether atomic
power would work,
and was in the water
barely six months
after the
experimental engine
first ran.*

*U.S. now has four
A-subs which have
surpassed—in real
seas—old Mark I's
imaginary cruise.*



Thanks to such heroic efforts, June 1953 saw Mark I churning at full power, theoretically deep in mid-Atlantic.

THEN it happened.

At Hour 60, the generators were in trouble. Carbon dust from the brushes had drifted into the windings.

Next the meters connected to the atomic reactor began to go haywire. Nobody could tell for sure what was going on inside the red-hot core, loaded with hundreds of pounds of the most dangerous fuel in the world.

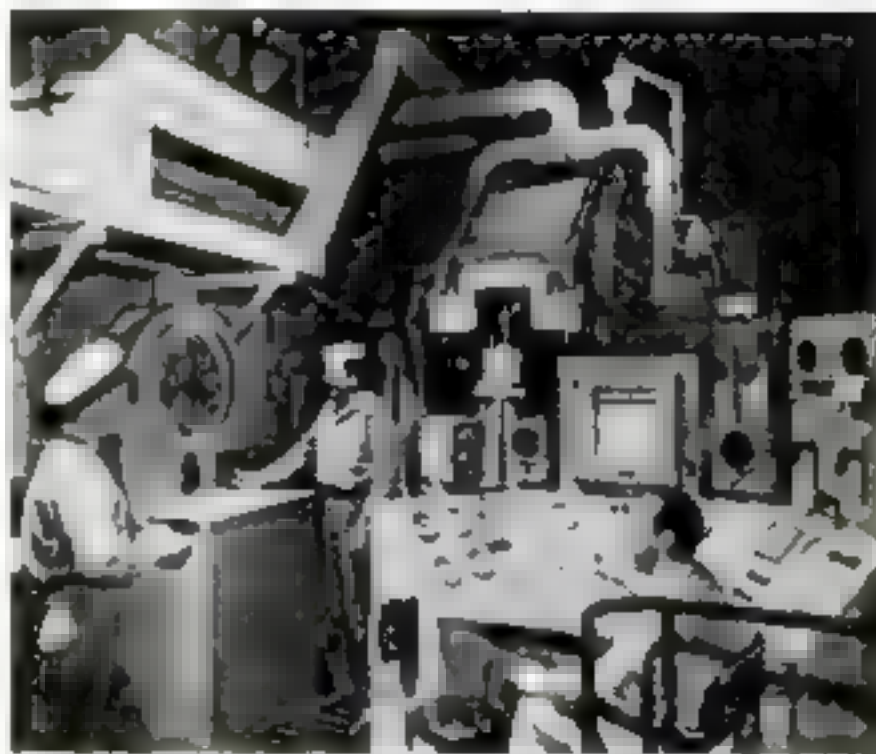
And one of the main pumps started screaming—a high, intermittent whine. The pumps are vital, forcing water between the uranium fuel rods to carry heat away. Without them the reactor would have to shut down—or burn up.

How hot was that core? Instruments erratic, pump dying—that could signal crud. (Crud means crud, but is sometimes explained as Chalk River Unidentified Deposit, after the Canadian reactor at Chalk River, Ont. The term had an ominous meaning for the atomic experts.

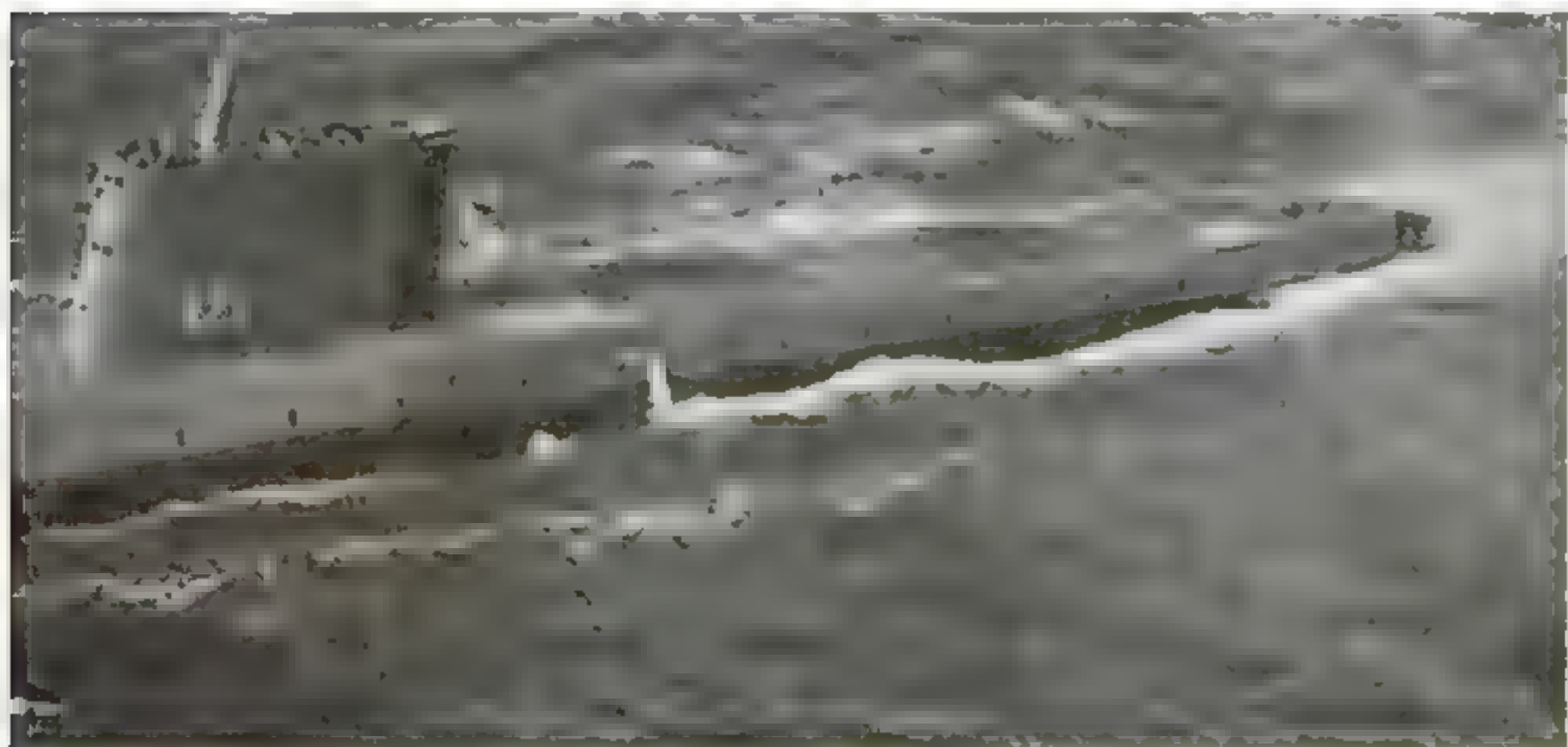
Six months before, the big reactor at Chalk River had run wild, burst some uranium containers, and spread deadly radioactivity.)

The crud problem had worried Mark I's builders from the beginning. High-intensity atomic rays corrode most metals badly. A test of a sample fuel element inside the Chalk River reactor was far from reassuring—the sample came out covered with crud.

If the prolonged full-power "cruise" was building up crud, the water passages through the reactor core might clog. The core would boil over like a rust-choked auto radiator. Lethal radioactivity would spew through the plant.



With no place to go, landlocked sub engine lacks prop. Drive shaft ends in water brake—big paddle wheel in tank (background), which absorbs power, indicates output on scale (left)



**DOUBLE-LENGTH
FEATURE OF
TRUE SCIENCE
ADVENTURE**



The payoff: Polaris missile is fired from under water by U.S.S. George Washington. Combination of hydrogen-tipped Polaris with A-sub makes defense system of unprecedented strength. Enemy can't find sub, is always vulnerable to its city-busting rockets.

At Hour 65 the situation grew suddenly worse.

Several tubes blew out in the main condenser. Steam pressure plummeted.

Now Mark I was limping badly. There was some danger of a steam explosion, no joke in a cramped submarine. And there was all that uranium, fissioning away none too calmly and threatening to go completely out of control. At the very least, serious damage to a \$30,000,000 plant seemed imminent.

The men at the site had every right to be worried, and they were. Westinghouse manager Al Voysey, responsible for the safety of his own men and for the very considerable investment that his company had riding on the deal, wanted out. He "strongly recommended discontinuing the run."

Commander Kintner telephoned Washington. The technical director of the Naval Reactors Branch hurriedly conferred with his staff. They pressed the Old Man to call the whole thing off. At once.

RICKOVER'S neck was stuck out a mile. In 1953 he was not yet a schoolboy's hero of a vice-admiral. Far from it. Instead, he was an obstreperous little gray-headed Jewish captain, widely disliked and twice passed over for promotion. In the Navy, twice-passed-over—considered and rejected by successive promotion boards—is the axe: prompt retirement.

He was about to get an unprecedented third chance for promotion. His undeniable genius had won over the prestigious politicians of the Joint Committee on Atomic Energy. His cause was being fought in the newspapers, some of which bluntly accused the Navy of anti-Semitism. The United States Congress directed the Navy to convene another selection board to reconsider his case. Rickover was to appear

before this special promotion board in two weeks.

An accident in Idaho would mean personal disaster for him. It would be unassailable justification for a third and final rejection of his promotion. He would be out, period.

Rickover ordered the cruise to continue.

He said: "If the plant has a limitation so serious, now is the time to find out. I accept full responsibility."

Mark I steamed on. Tension mounted. You could see it. Every watch that came on duty was on trial—"We won't be the ones to quit." Anything that could be fixed while the engine ran, they fixed.

Twice they had to throttle back to half power, once to two-thirds power. But inch by inch the position crawled across the map to Ireland.

And made Fastnet.

The long-odds gamble was won. Today we have four atomic subs on patrol, with 19 more soon to come. We have 10 atomic electrical plants, with 25 on the way. We have them partly because of a courageous cruise eight years ago. ■ ■

**You can throw away
the starter rope**

Power Starter for a Power Mower

By Herbert R. Pfister

PULLING a starter rope to fire up a power mower, cement mixer, or other "laborsaving" machine is not my idea of saving labor. It's hard work.

When a one-lung engine balks, or if overchoking floods it, hand-starting can be a heart-straining effort, as frustrating as cranking a car in the days before electric starters.

It makes sense to let an electric motor do the work for you. It won't tire. It will crank a stubborn engine steadily to clear a flooded cylinder and excite the magneto into producing a fat spark.

How others did it. Herbert L. Phillips of Watertown, Mass., developed a starter to kick over a husky 4½-hp. snow

MOTOR ON DOLLY cranks engine until it starts. At first sputter, dolly is tilted forward to let engine run free; belt flies off like a lariat (upper photo). Choke is not used; it would flood the engine.

CONTINUED



Starter will fire up any engine that can be reached with V belt

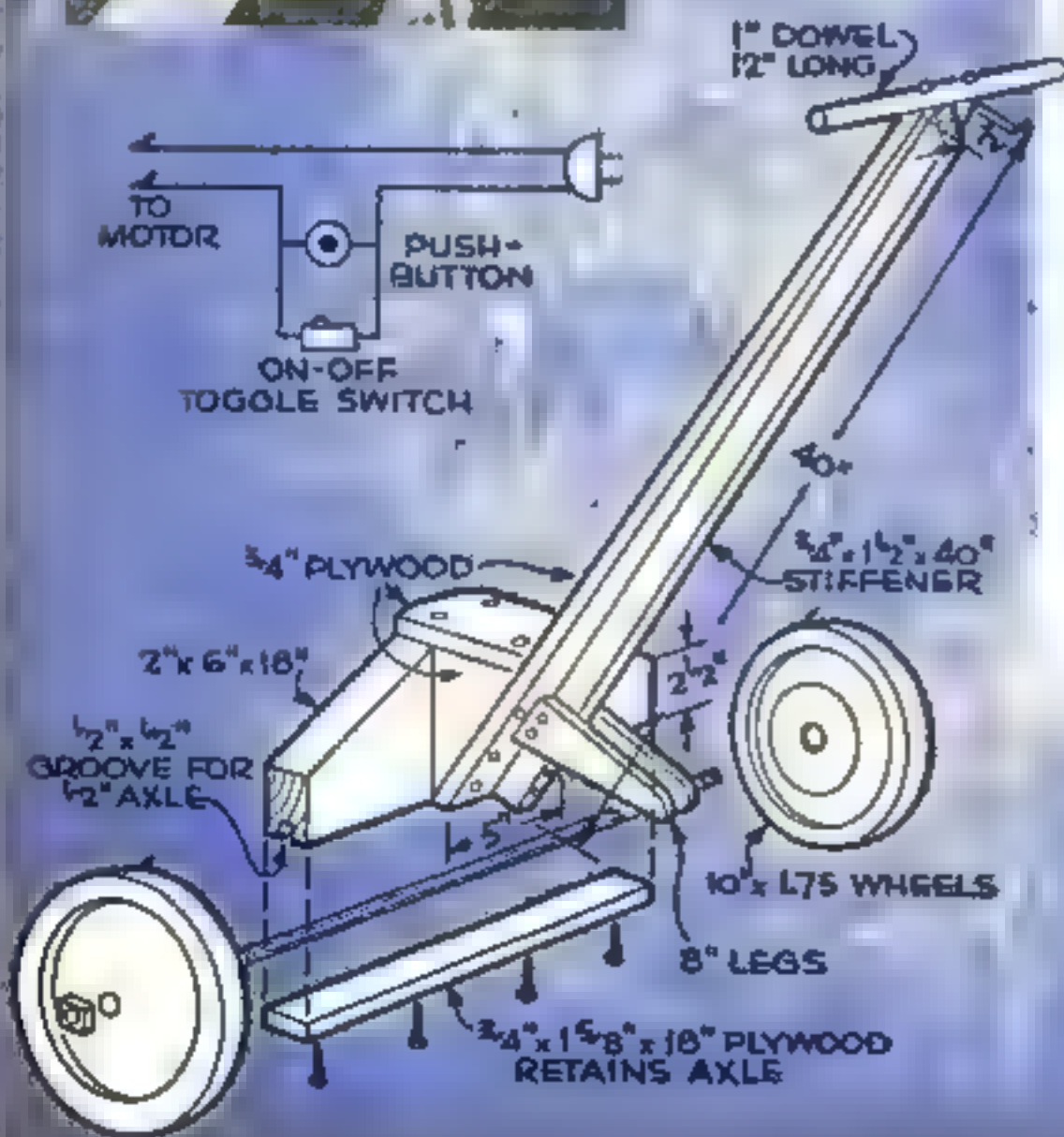


HUSKY ENGINE on snow blower or riding mower starts without effort when cranked steadily by motor. A $\frac{1}{4}$ -hp. motor will start most small engines, but $\frac{1}{2}$ hp. is best for turning over engines of more than $2\frac{1}{2}$ hp.

REEL-TYPE MOWER is started from behind. Height of motor on dolly is not critical when starting engines having horizontal shafts. Just align the pulleys, one behind the other.

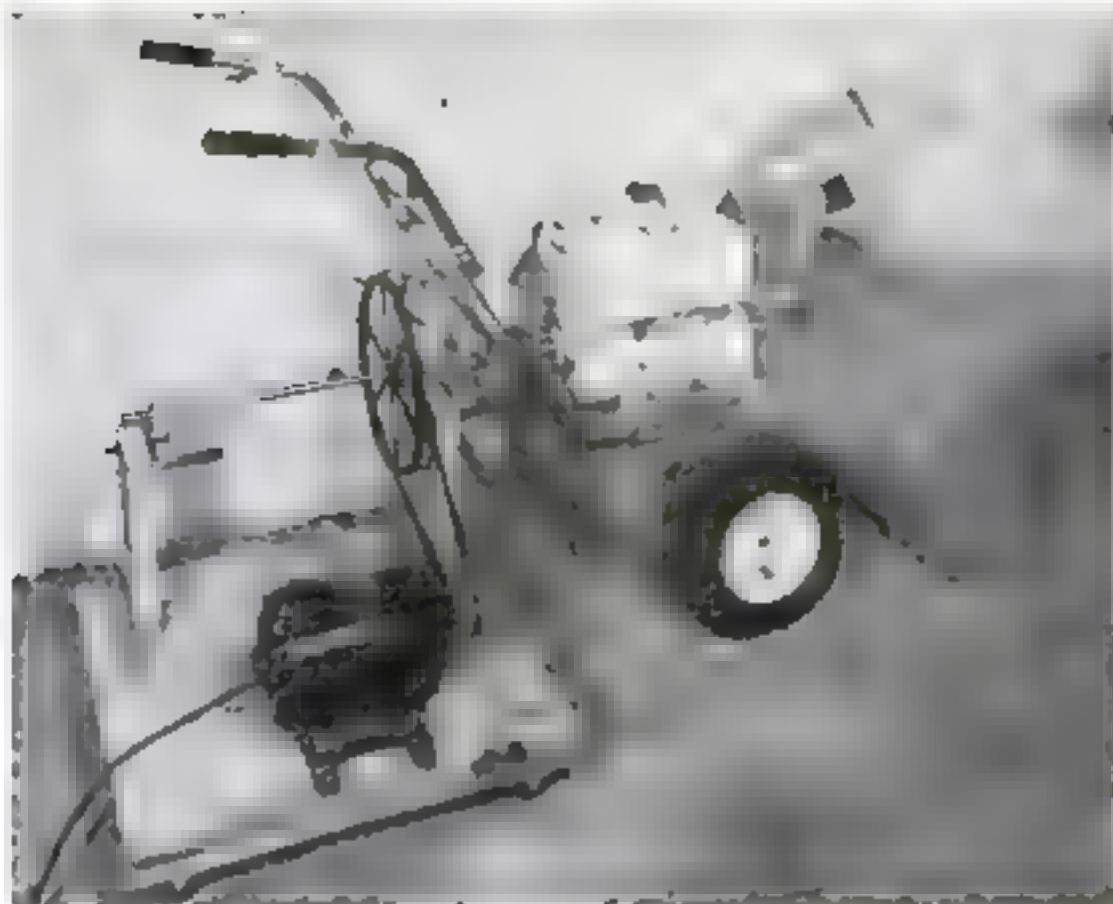


PUSHBUTTON provides fingertip control of starting motor. On-off switch is wired parallel to button (drawing below) for continuous operation of motor.

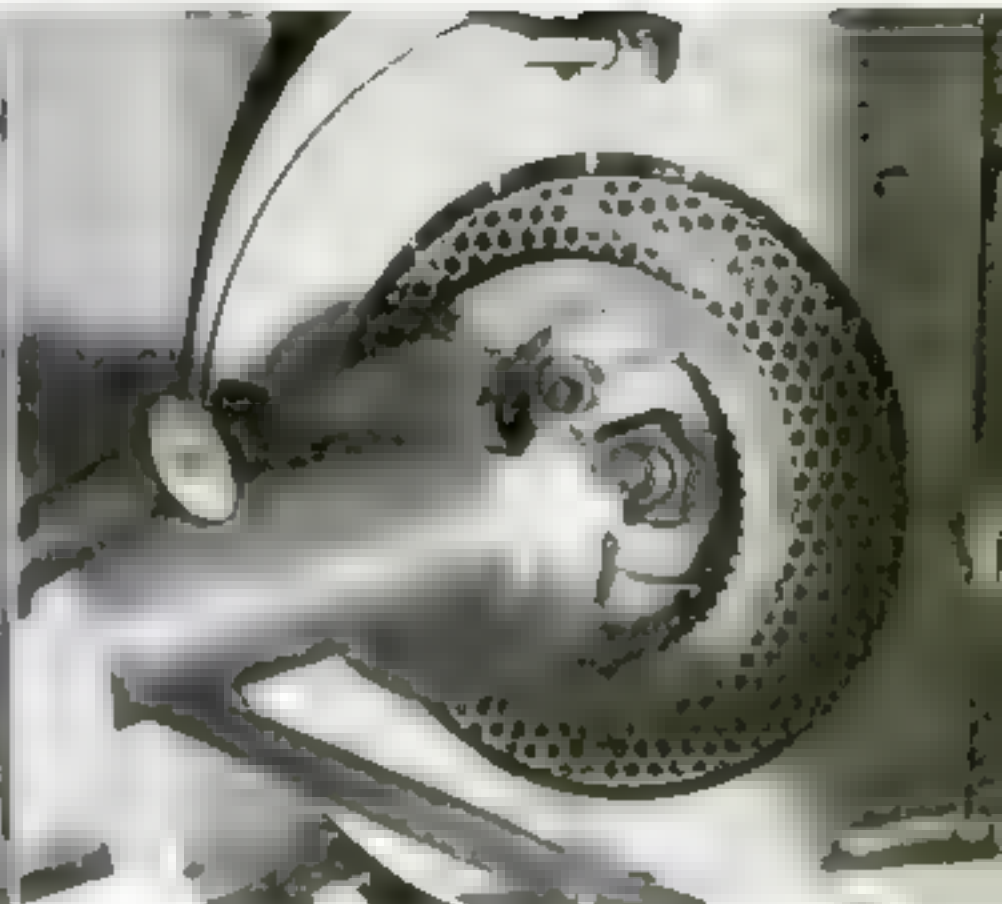


GARDEN SPREADER can be used instead of the dolly shown at left, saving you time and the cost of a pair of wheels. Mount the motor on a plywood platform clamped to the hopper with cleats tightened on its flanges with bolts and wingnuts.

How two PS readers use a motor for starting



COLD-STIFFENED 4½-HP. ENGINE on this snow blower starts easily in spite of freezing temperatures when Herbert Phillips cranks it with notched flange driven by a ½-hp. motor. Close-



up of flange shows notch that catches head of cap screw to crank the engine. When engine starts, screwhead pushes against tapered side of the notch, disengaging the flange.

thrower in freezing weather. A cranking flange driven by a ½-hp. motor nudges his thrower into action. When the engine starts, the flange automatically disengages. This setup can be adapted to any engine having a horizontal shaft.

A. W. Aiken of St. Petersburg, Fla., simply bolted a washing-machine motor, pulley shaft down, on the garage wall at the same height as the rope pulley on the vertical shaft of his rotary mower. A V belt between the two pulleys spins the mower shaft.

How I did it. I mounted my starting motor on a dolly so I can roll it to the mower or other equipment around my place. Its range is limited only by the length of the extension cord I keep in the garage. All I need to switch the starter from one machine to another is a V belt of the right length to reach the crankshaft of each machine.

A few light mowers have a notched pulley used for starting the engine with a rope. The V belt from the motor can be used to drive this pulley without altering the engine in any way.

To prepare most other engines for electric starting, you must remove the recoil starter and install a 5" or 6" pulley on the shaft. File a notch in the outer flange of this pulley so you can restart the engine with a rope if it should happen to



WHAT COULD BE SIMPLER? A. W. Aiken mounted a motor upside down on a garage wall to spin his rotary-mower engine until it starts. Moving mower toward the motor releases the V belt.

stall beyond reach of your extension cord.

Starting up is easy. I roll the dolly up against the side of the machine and tilt the handle up so the belt can be placed on the pulleys. I then press the button to turn on the motor, and slowly tilt the handle back to tighten the belt against the rotating pulley. The effect is like that of the belt-tightening clutch on

How to mount a starting pulley on a small engine

CAUTION: Remove spark plug to keep engine from starting accidentally



IF THERE'S A RECOIL STARTER, remove it to expose the rope-starting attachment beneath it.



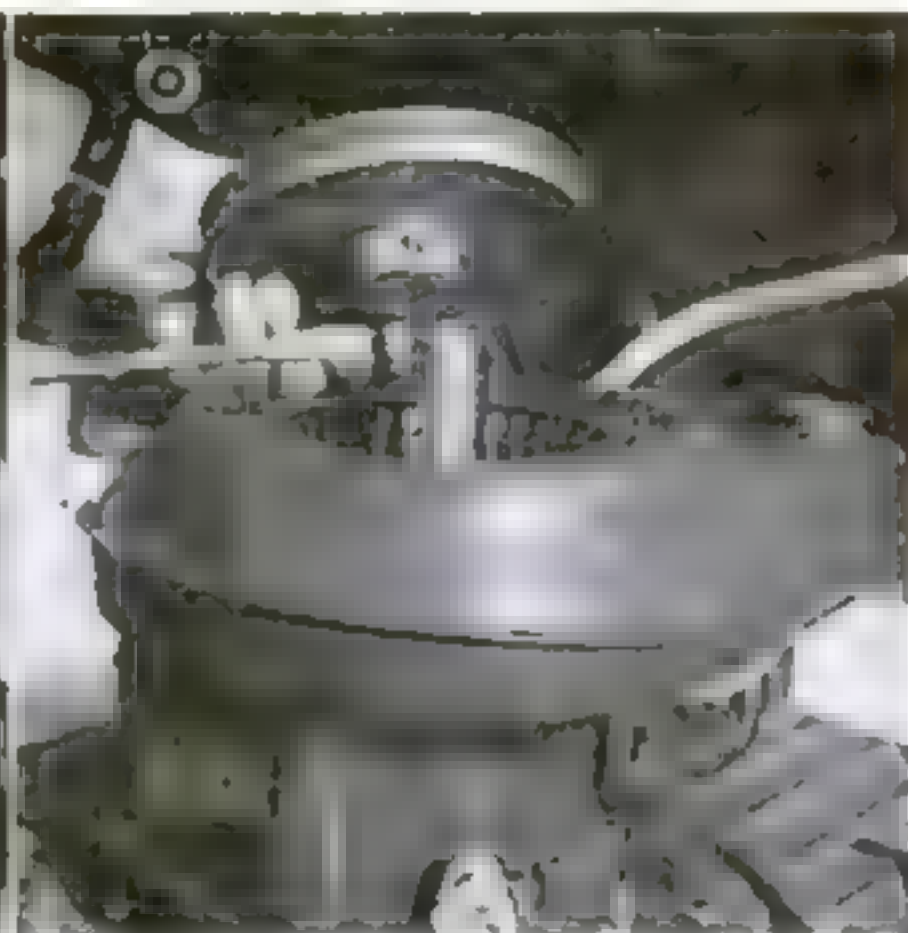
LOOSEN NUT ON SHAFT; remove rope-starting attachment (sometimes a pulley).



FILE A FLAT, approximately 3/16" wide, on one side of the threaded engine shaft.



FASTEN SHORT EXTENSION—a motor-shaft arbor, or rod bored to fit—on the end of the shaft.



LOCK PULLEY ON SLEEVE, which also has had a flat filed on its side for pulley setscrew.

a mower or light scooter. When the engine fires, I tilt the handle forward again, and the belt flies off the pulleys like a lariat.

By letting the motor build up its r.p.m.s *before* tightening the V belt, almost any spare 1/4-hp. motor can be used to start engines up to 2 1/2 hp. For huskier engines you should use a motor of 1/2 hp. or better and of the capacitor or repulsion-induction type that will start under load.

The dolly is easy to make from scraps of plywood and a short piece of two-by-six, but you can save even that trouble

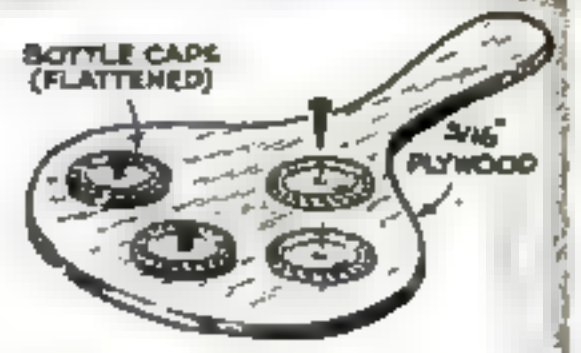
by fitting a plywood platform over the hopper of your seed-and-fertilizer spreader to support the motor. Removable cleats can be used to fasten the platform to the flange around the top of the hopper. The motor switches can be mounted on a small square of plywood fitted with a spring clip to snap it on and off the handle.

A bonus in utility. The motor and dolly need not be limited to starting engines. Fitted with a flexible shaft, the motor supplies plenty of power for polishing the car, grinding and sharpening garden tools, sanding, and drilling. ■ ■



Short Cuts and Tips

FROM THE READERS

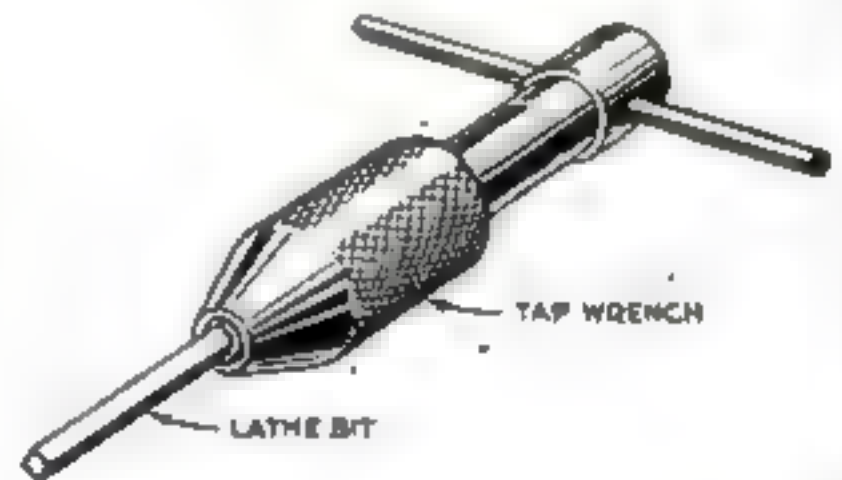


Music-Making Fun from Bottle Caps

HERE'S a Latin-American music maker that's fun at parties. Jigsaw two paddles from plywood and loosely screw three pairs of flattened bottle caps to each one. The caps will rattle like a tambourine when you shake the paddles.

Make-Do Lathe-Chuck Wrench

INSTEAD of wasting time searching for a misplaced lathe-chuck wrench, slip a square cutter bit in a tap wrench and use it to tighten the chuck. If the chuck has a hex opening, cut off a piece from an Allen wrench and use it in the tap wrench. The missing wrench will probably turn up sooner or later. Until then, this works fine.—*W. B. Goodrich Jr., Somerville, Mass.*



Nonslip Steps for Ladder

You can reduce the possibility of slipping while working on a stepladder—even when your shoes are wet or greasy—by covering the steps with safety treads cut from mineral-coated asphalt shingles.—*Robert E. Williams, Canton, Ohio.*

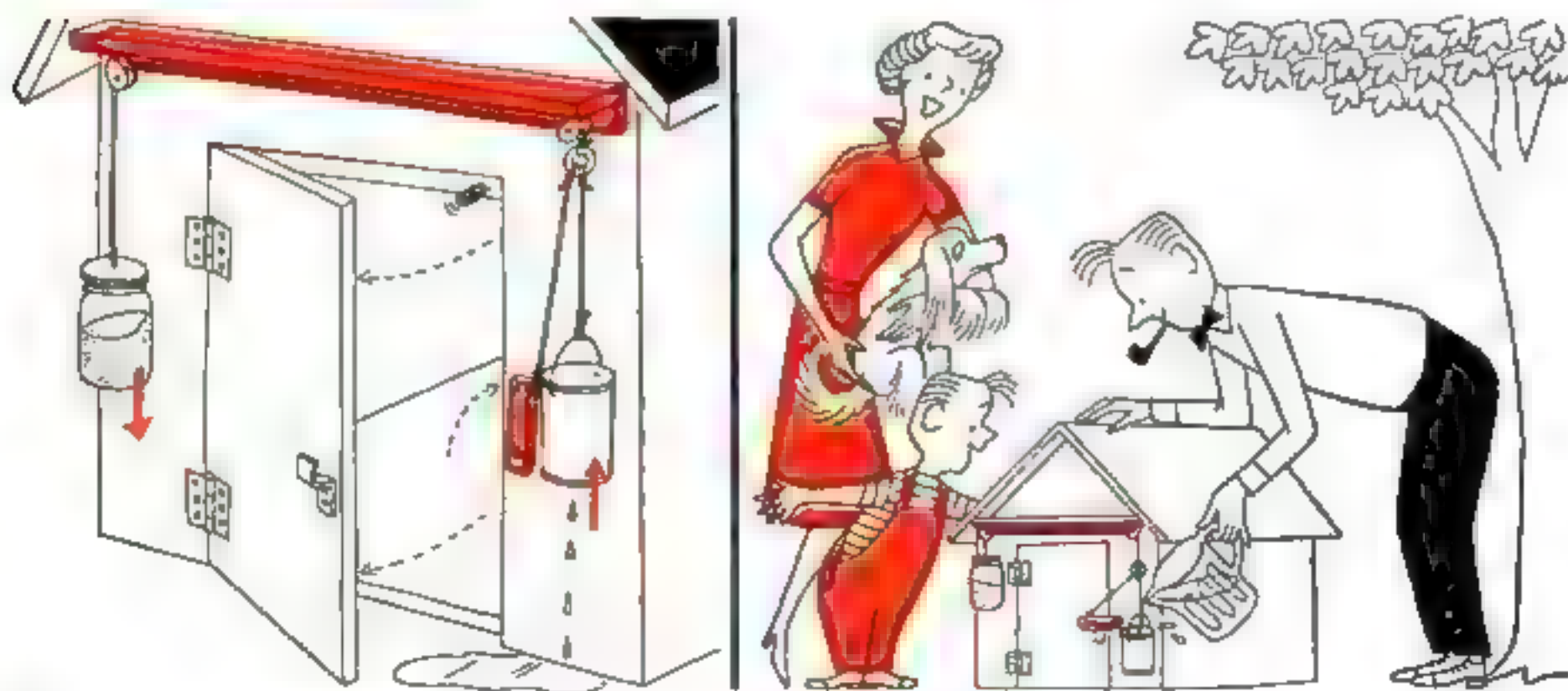


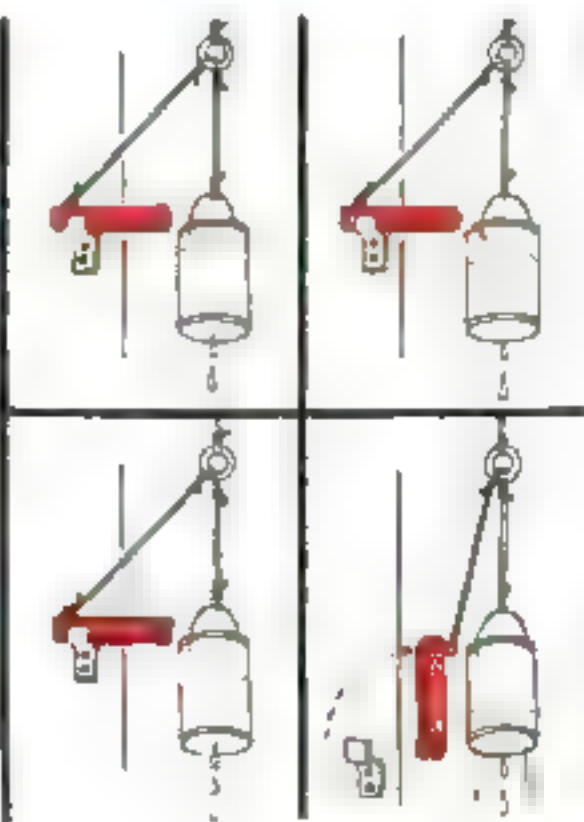
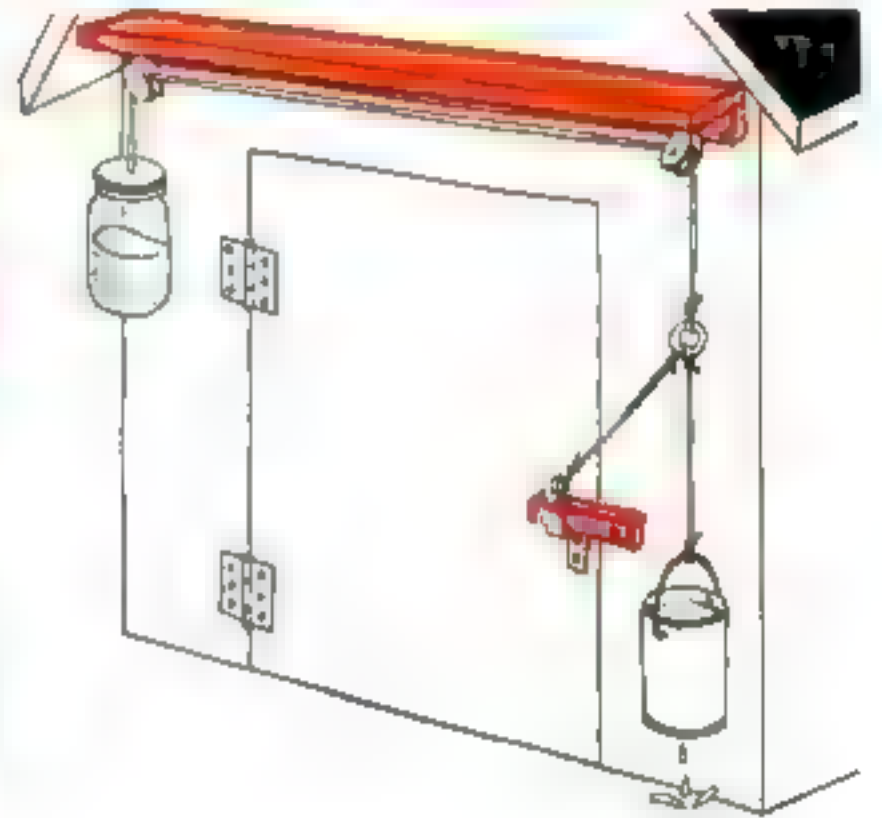
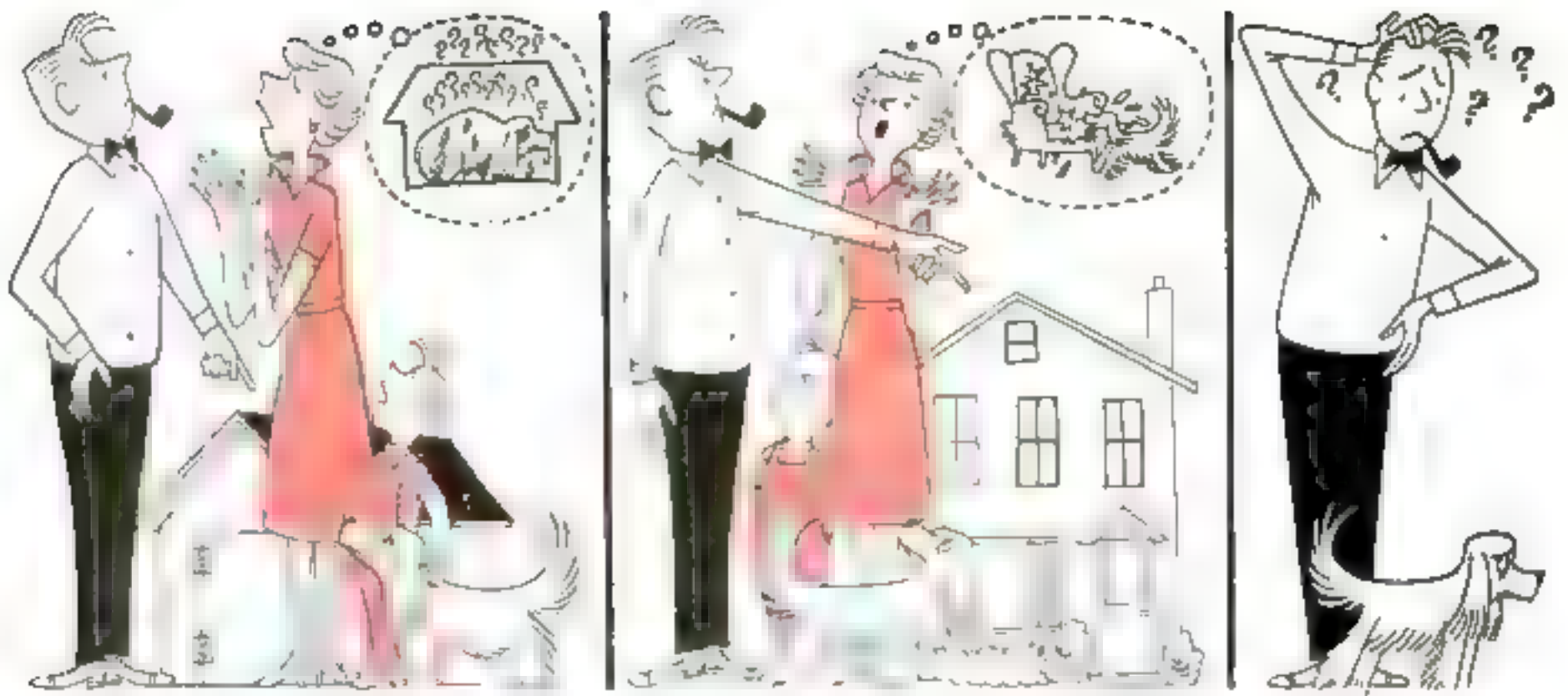
Poncho from a Tablecloth

You can quickly make an emergency poncho from a sheet of any of the filmy plastic materials, or a plastic tablecloth. Cut it as shown and thrust your head through the center opening.—*Norman J. Pederson, Seattle, Wash.*

Wordless Workshop

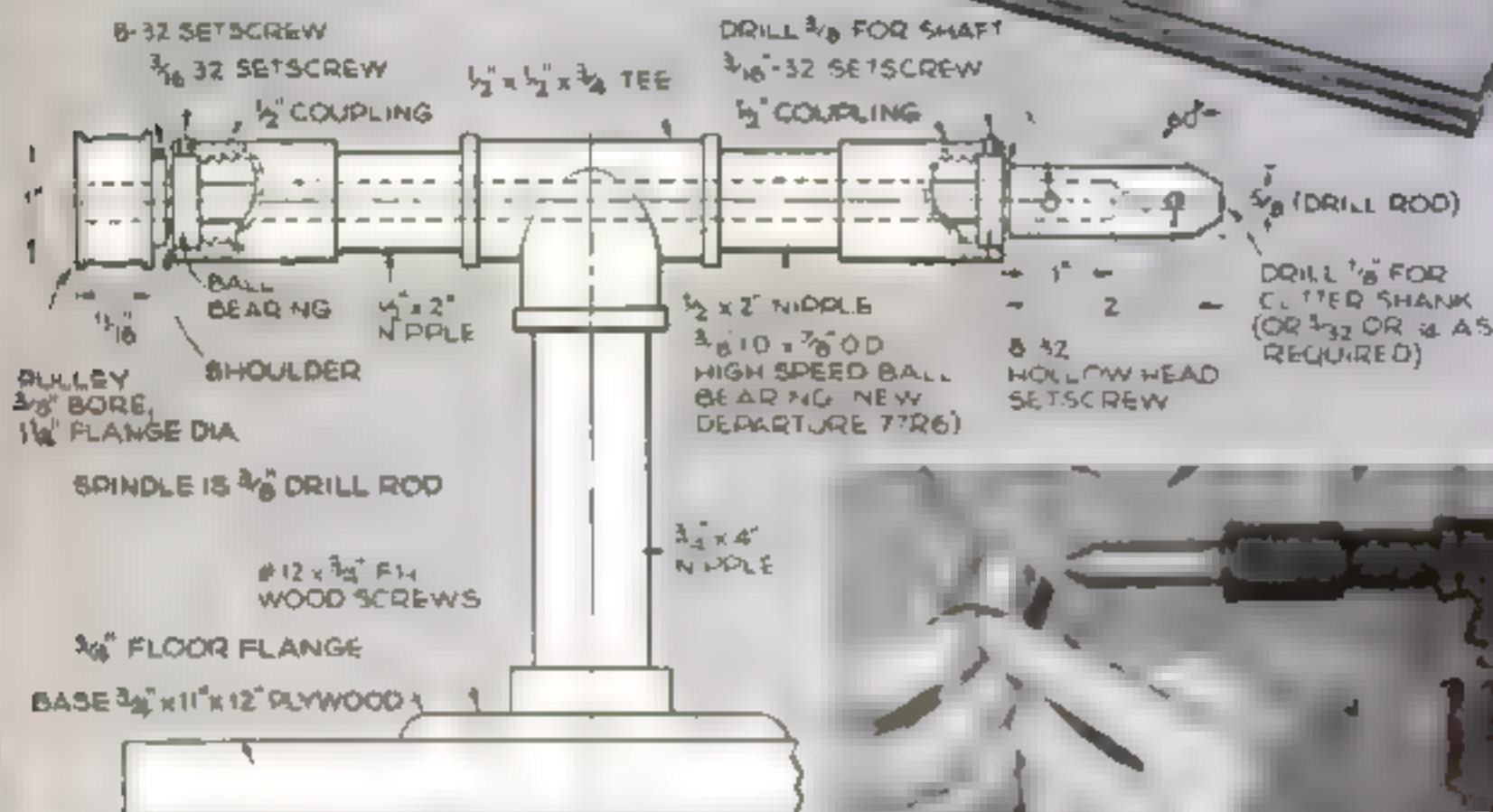
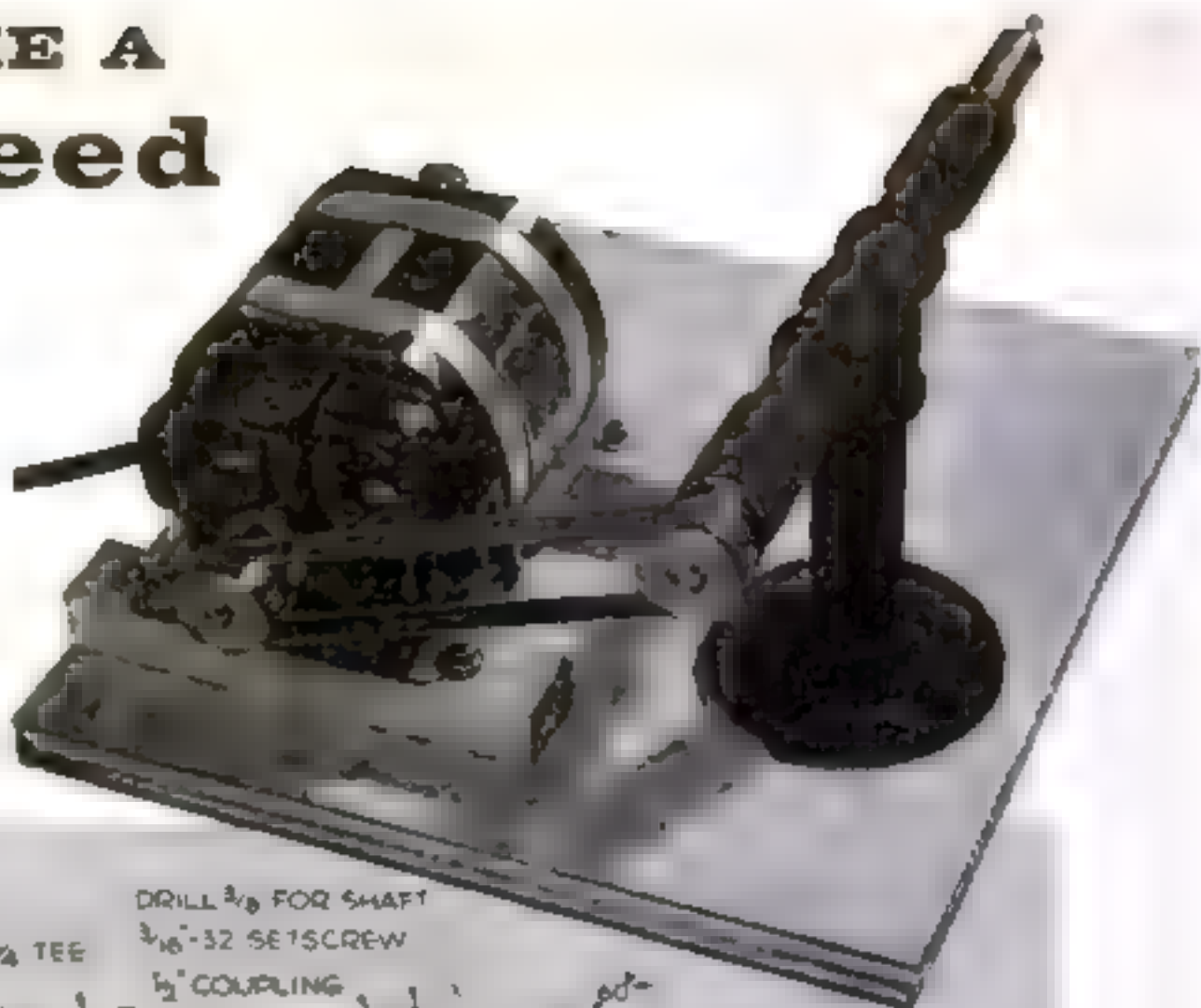
By Roy Doty
and Jim Davis





HOW TO MAKE A High-Speed Cutting Spindle

METAL ADJUSTMENT PLATE that comes on a Dictaphone motor has an adjusting screw underneath that moves motor back and forth to tighten belt. Mount plate on wood runners to allow clearance for operating screw.



FIT this homemade high-speed spindle with an appropriate cutter and you can easily dispose of many tedious shop jobs. As a freehand milling machine or a fast-working wood-carving machine, it offers new scope to machine, wood-carving, and modelmaking projects.

The motor from an old Dictaphone cylinder-shaving machine is an ideal power source. These are no longer made but you can often pick them up inexpensively from a Dictaphone agent. However, you can use any high-speed universal-type motor, such as one from a vacuum cleaner.

The spindle housing and stand are made from standard $\frac{1}{2}$ " and $\frac{3}{4}$ " pipe fittings. The only machining needed is to bore one end of each $\frac{1}{2}$ " coupling to fit the high-speed ball bearings. Assemble fittings as shown in the drawing and screw them up tight. Cut the spindle from $\frac{3}{8}$ " drill rod. Make it 2" longer than the spindle housing. Machine the spindle pulley from $1\frac{1}{4}$ " steel rod, the chucks from $\frac{5}{8}$ " drill rod. Make separate chucks for each size cutter shank. Any cutters, grinding stones, etc., made for high-speed hand grinders can be used.
—Manly Banister, Portland, Ore.



Short Cuts and Tips

FROM PG READERS

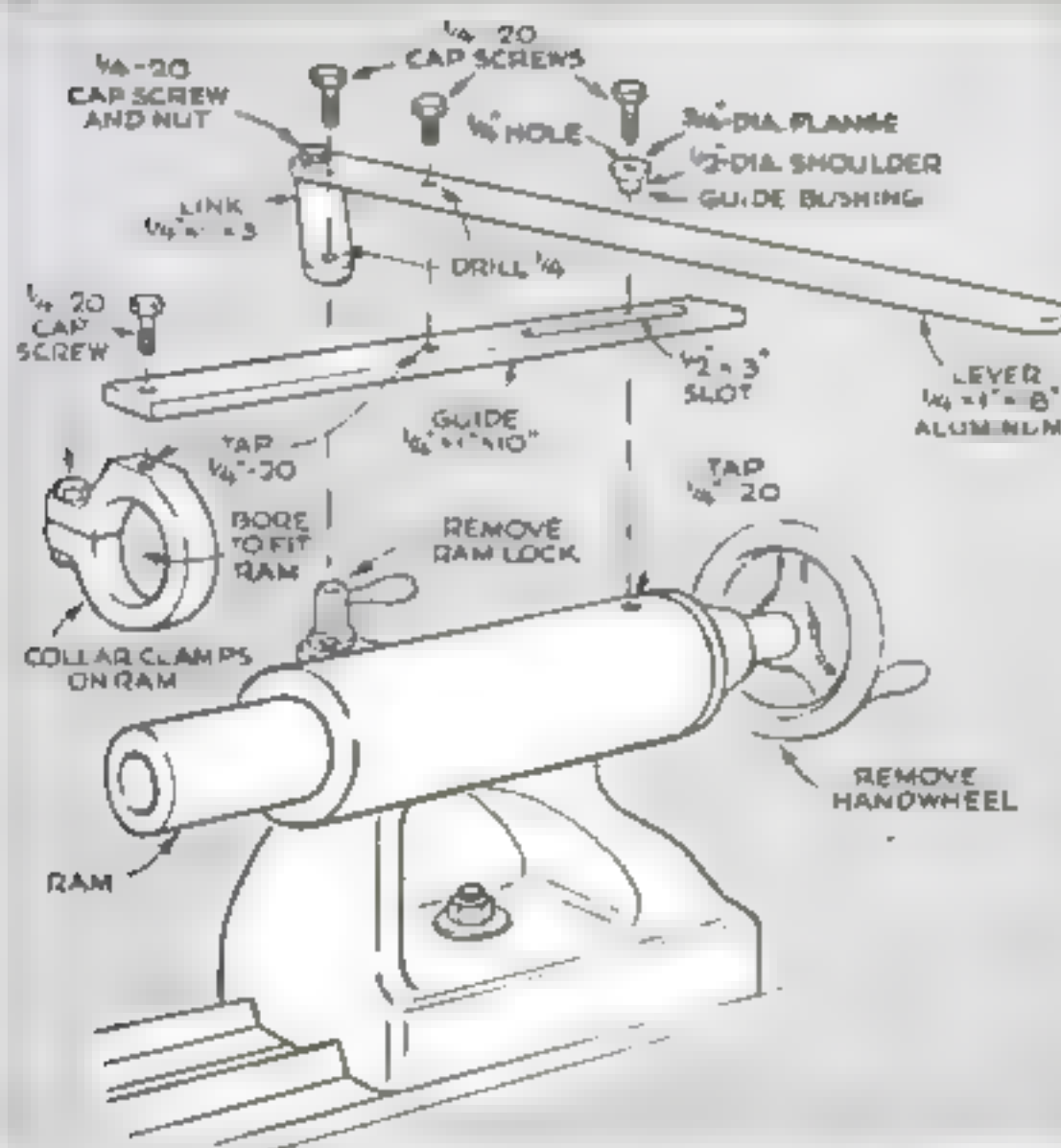
Tailstock Feed Lever Fits Any Lathe

A QUICK-ACTING hand lever installed in place of the slow-moving handwheel on your lathe tailstock can speed drilling, reaming, tapping, and other operations that require feeding in and backing out the tailstock ram.

Dimensions given in the drawing are general, to show proportions, since the accessory can be built to fit any lathe. Do-it-yourself aluminum strip ($\frac{1}{4}$ " by 1") is used for all parts except the ram collar, which is made from $\frac{1}{2}$ " flat brass or aluminum.

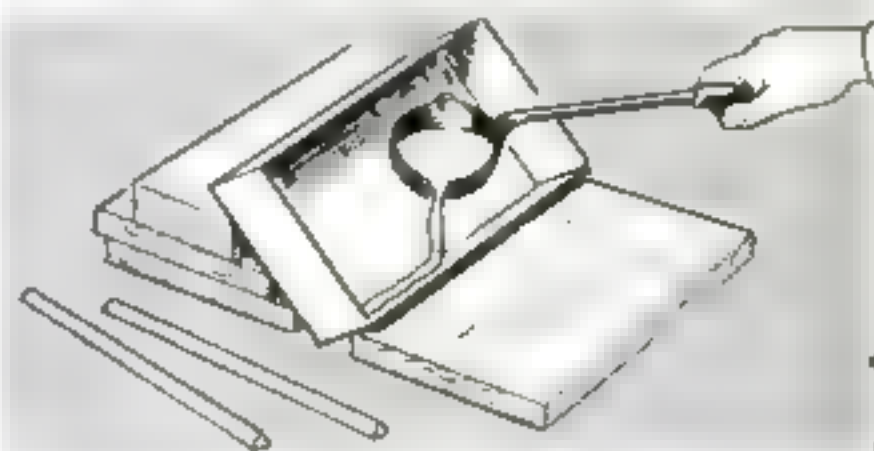
Installation is quick and easy. Only one $\frac{1}{4}$ "-20 hole must be drilled and tapped in the tailstock casting. This is for the bolt that holds the guide bushing in place. The other bolt, connecting the short link to the tailstock, is threaded into the hole normally used for the ram lock. The split collar is clamped on the ram to link it to the hand lever.

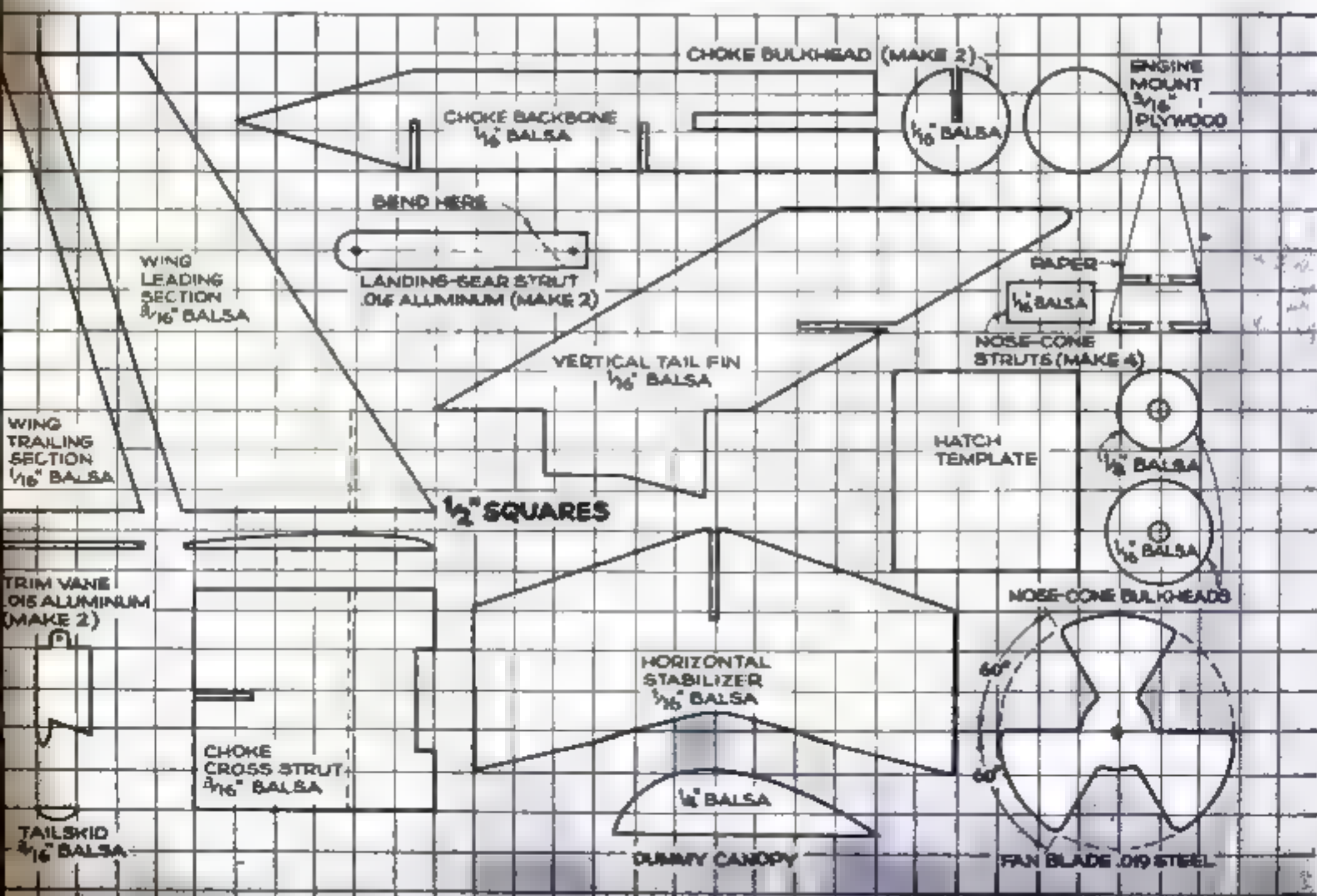
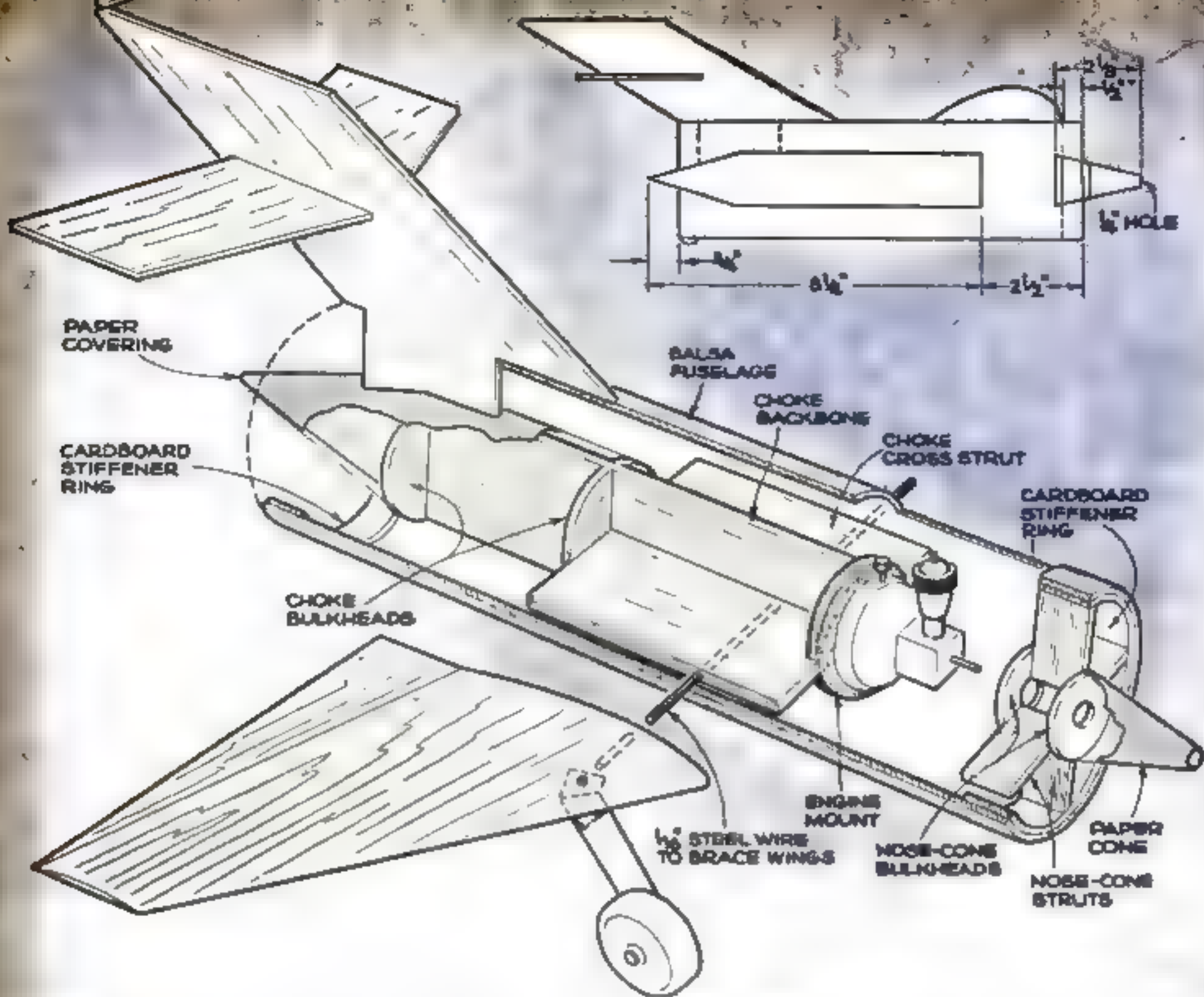
When not needed, the lever assembly can be removed from the lathe in a few minutes, and the tailstock restored to handwheel operation.—Floyd McGuckin, Ridgewood, N. J.



Using Bar Solder More Easily

BAR solder is hard to use on small jobs because it's awkward and requires extra heat. You can remold such solder by melting it and pouring a little into a cardboard box propped at an angle. The thin, triangular stock that results is handy to use and melts as easily as wire solder.—Walter Fehlberg, La Crosse, Wis.







**Here's a speed demon
on a tether:**

A Ducted-Fan Flying Model

By Roy L. Clough Jr.

IT LUMBERS along the ground, suddenly picks up speed, rises howling into the air, and becomes a flashing blur of color. This striking performance is what you get with a "ducted-fan" plane—one of the newest and most exciting glow-plug models to build and fly.

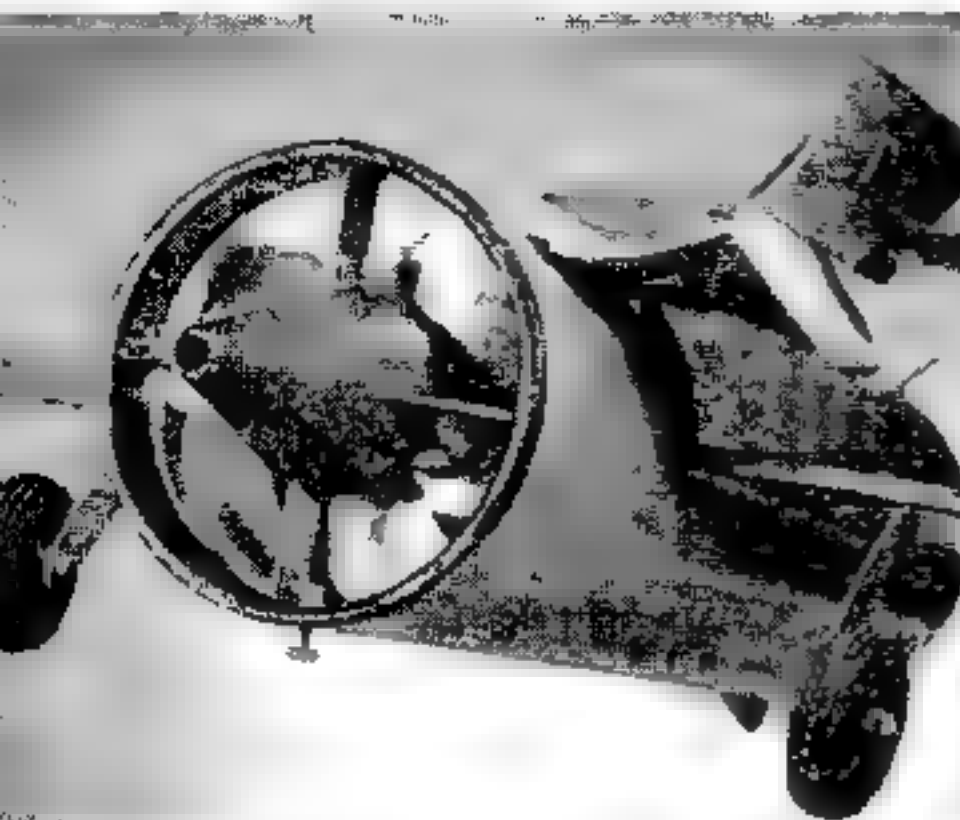
The model is patterned after full-scale ships called "barrel" planes because their fuselage is literally a barrel-like cylinder with the engine inside. The ducted fan works on the principle that a blade turn-

ing inside an enclosed housing or tube can move more air more efficiently than the same blade operating in the open. The plane, instead of pulling itself through the air, is actually pushed through it by a strong jetlike thrust that makes possible high speed on relatively little power.

The design shown here is also a completely new and fascinating type of ducted fan. Some earlier models proved sluggish and troublesome because they consisted merely of a prop spinning inside a hollow tube. As air passed the

CONTINUED

127



SPIKE-SHAPED NOSE squeezes air ahead of the prop, speeding it up and adding thrust. Note obstruction-free fuselage and wide-set wheels—nothing to foul up a fast, safe landing.



IT'S A TIGHT SQUEEZE for engine and prop inside the barrel fuselage, but you can reach them easily through this large hinged hatch. Prop is spun automatically by spring starter

prop, it slowed down in the big open tube behind it and became turbulent because there was nothing to direct its flow, resulting in a loss of thrust.

In the new design, a nose cone speeds up the air and smooths it out before it reaches the prop. A second cone, called a choke, is mounted behind the prop. This squeezes down the volume of the tube, forcing the air to speed up and channeling its flow in a straight line so it can't become turbulent. The result is a much higher thrust than was possible with earlier nonchoked models.

You fly it without controls. The plane is designed to fly around a central post or pylon, but an ingenious method of control eliminates the need for movable tail surfaces. You use only a single, short line, which means you don't need a football field to operate in. You can fly the plane in any tiny patch of yard or even in a good-size cellar.

You just fire the model up and let it go. It takes off, climbs to a fixed altitude, and lands itself. The trick is based on the fact that a spinning prop acts like a gyroscope. When a gyroscope is moved, it exerts a force at right angles to the original line of movement—called a precessive force. Since the plane is always being pulled in toward the pylon sideways, the prop exerts a precessive force upward, raising the nose. As speed increases, the fixed horizontal stabilizer tends to push the nose downward and

flatten the plane out. As long as the two forces balance each other, the model flies level.

When the power is cut, the nose falls and the plane goes into a short, fast glide of about two laps around the pylon, then dead-sticks neatly in on its gear. Because the prop is small and shrouded, there's no chance of its breaking or causing a nose-over.

Small metal vanes at the rear of the fuselage enable you to trim the thrust line so the gyroscopic and stabilizing forces will balance. These should be set slightly downward at the start and adjusted as needed to make the plane fly level. Because of the gyroscopic action, the plane must always be flown counterclockwise when using a clockwise prop. If it's flown the other way, the precessive force would be downward and you'd never get it off the ground.

The design is so efficient you don't need a large, heavy engine. The one used here is the Cox .020, one of the smallest engines made. Prop pitch and duct volume have been worked out to match this power plant. Larger engines can be used, but they may require adjustment of the blade pitch to permit them to operate at peak r.p.m. efficiency.

Forming the fuselage. A cardboard mailing tube with an outside diameter of $2\frac{3}{4}$ " makes a perfect form for shaping the tubular fuselage. Three 10"-by-3" sheets of $\frac{1}{8}$ "-thick balsa are boiled 10



METAL TRIM VANES at after end of the choke cone control the thrust angle; they should be set slightly downward as here. The fixed tail surfaces are braced by toothpick struts.



THREE-BLADED PROP is easily installed or removed by inserting a screwdriver through the hollow nose. Paper strip on inside edge of hatch opening keeps hatch from falling inward.

minutes to soften them, and then wrapped around the mailing tube as shown.

Later, the tube becomes a gluing jig for joining the three curved balsa sections into a cylinder. Later still, two $\frac{1}{2}$ "-wide ring sections are cut off the same tube and cemented inside the ends of the fuselage to stiffen it. Round off the edges of these rings to provide a smooth air passage.

The nose and choke cones are built up by covering circular balsa bulkheads with a thin, stiff, hard-surfaced paper such as light Bristol board or strips cut from a Manila file folder. The choke cone is supported in the center of the fuselage by a single cross strut at the front and the tail fin at the rear. Bolt the engine to the circular mount before covering the

cone with paper, and place dabs of cement over the nuts to keep them from loosening.

The fan blade is easy to make. This is simply a $2\frac{5}{8}$ " disk of thin steel divided into six identical 60-degree segments. You cut away every other segment, leaving three equally spaced 60-degree blades.

The blades are bent at an angle of about 26 degrees to the hub—the exact pitch is not critical. Be sure that the blades flare outward on the edges that face the direction of rotation so they'll bite into the air. Cement a couple of small fiber washers to the center of the fan to build up a hub.

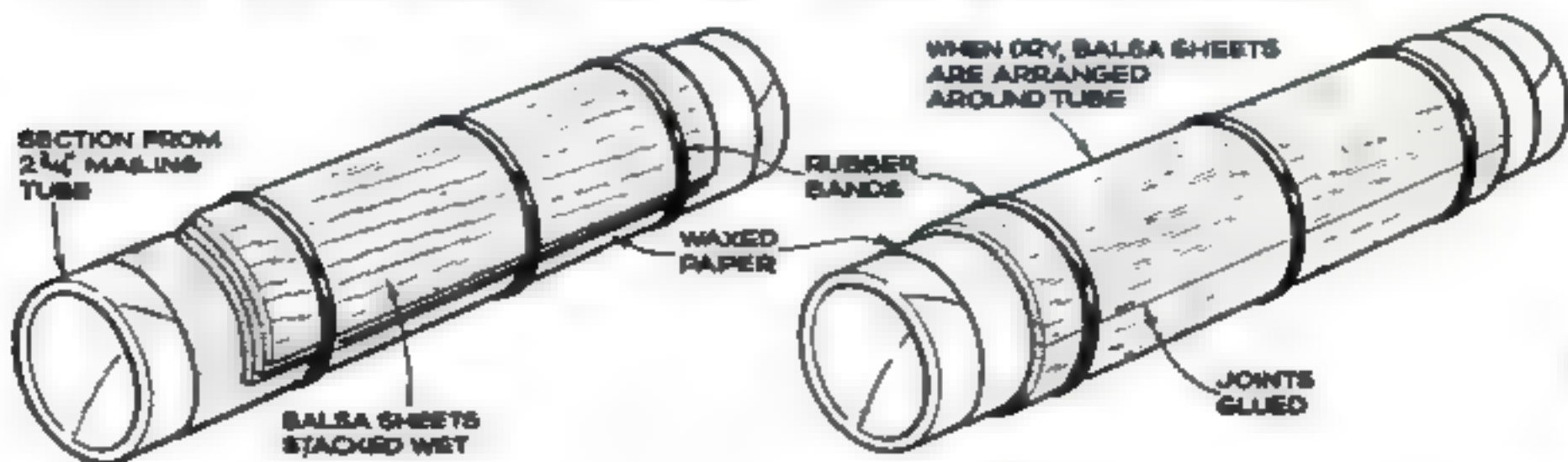
Mount the fan on the engine and use its tips as a guide for exact centering of the choke cone as you glue it in the

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How the fuselage is formed around a mailing tube

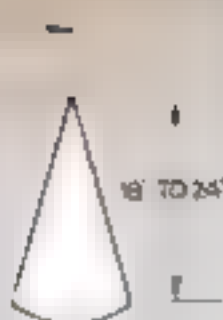
MAILING-TUBE FORM makes it easy to shape a perfectly cylindrical fuselage. Three sheets of balsa are boiled to soften them, and fastened to the tube with rubber bands, as below at left.

When dry, the curved sheets are placed around the same tube, as at right, and trimmed and glued. Waxed paper lets you slide the cylinder off the tube without its sticking.





6 TO 8'



UNLIKE OTHER MODELS, the ducted fan flies best close to earth with the tether level. Use a low pylon and a short line, and adjust the ship so it flies at a fixed altitude of about 2'.

fuselage. Cover the choke cone and inner surface of the fuselage with several coats of hot-fuel-proof dope to protect them from oil spray.

The nose cone is supported by four struts cemented in between the balsa bulkheads. Note that the struts do not pass all the way through the cone; they leave a hole at the center. This enables you to insert a screwdriver through the cone to reach the screw on the blade.

The tail is attached by inserting its tab through a slot in the fuselage and cementing it to the choke cone. Be sure that both tail and cone are properly lined up. Cement the two aluminum trim vanes between the cone and the inside walls of the fuselage. They'll still be free to bend after they're installed.

The wings are each made up of two strips of balsa glued together—a thick leading section shaped to an airfoil, and a thin, flat trailing section. This is not important aerodynamically, but gives the wings the appearance of having separate, working control surfaces and also lets you make up the required width from narrow strips of balsa. If you prefer, the wings can be made in one piece with a continuous airfoil shape.

The wings are glued directly to the outside of the fuselage and do not pass through it. A steel wire is inserted through the fuselage, however, and then into each wing section to brace it. The landing-gear struts, bent from aluminum,

are fastened to the leading edges of the wings $\frac{7}{8}$ " out from the fuselage with small machine screws. The top of each strut is bent over to form a tab through which the bolt is run.

A short metal tab, held by the left-hand landing-strut bolt, provides an eye for attaching the plane's tether. Wheels are the standard $1\frac{1}{2}$ "-diameter rubber-tired type available at hobby shops. These are mounted on small nut-and-bolt axles through the struts.

An unusually large hatch makes it easy to reach the prop for starting—a feature not found on many ducted-fan models. A coil-spring starter, available as an accessory, also enables you to wind up the prop and let it go without the usual prop-twirling difficulties.

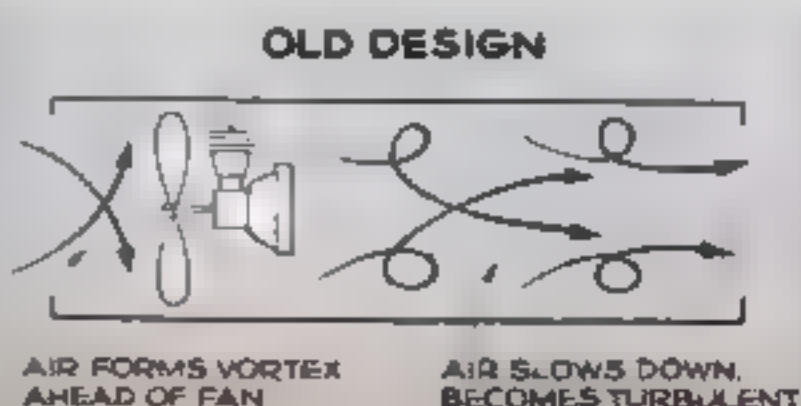
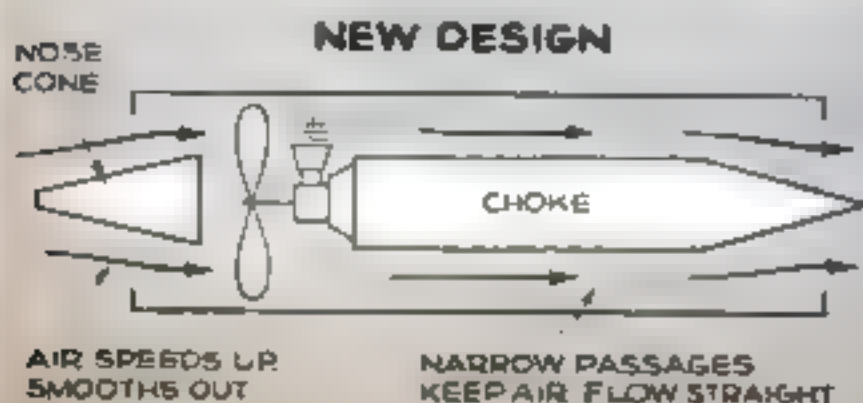
Form the hatch by first laying the template over the top of the fuselage $\frac{1}{2}$ " back from the leading edge, marking the outline, and then slicing out the section with a razor blade. One side of the hatch is then hinged with a strip of cotton tape. The other side is held closed with a small rubber band looped through tiny wire hooks cemented to the hatch and to the side of the fuselage.

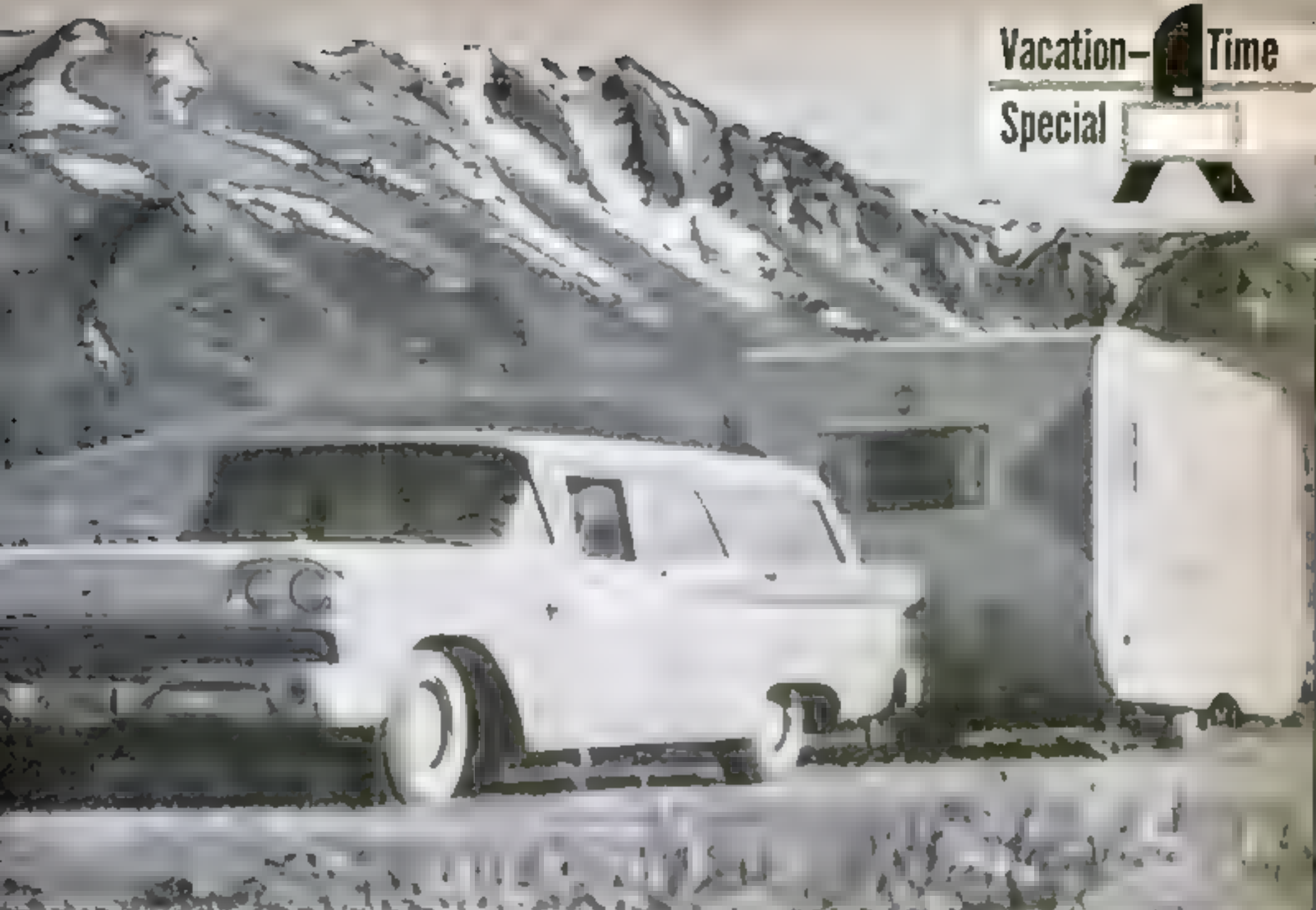
Cement the dummy canopy to the top of the hatch but not to the fuselage, so the hatch is free to open. The silhouette of a pilot can be painted on the sides of the canopy for a final touch. Add your favorite color scheme and the unusual plane is ready for her first flight test. ■ ■

Why the new ducted-fan design flies much faster

IN OLD-STYLE DUCTED FAN (below, right), air approached fan in a vortex instead of smoothly. After passing fan, it slowed down and became turbulent, wasting thrust. In new design, at

left, nose cone speeds up the air like an airplane wing. The choke then squeezes it, speeding air up more and guiding it straight to prevent turbulence and increase thrust.





I Say Trailer Travel Pays Off

By V. Lee Oertle

AFTER centuries of progress, perhaps man's strangest behavior pattern is the summer urge to "go ape"—a return to primitive surroundings.

I confess to being among these throwbacks. But for me and mine, the reversion is quite painless. My family no longer quakes at the phrase "camp out." Since I bought a travel trailer—one designed for camping trips—outdoor life has been thoroughly enjoyable. I'm beginning to believe what the trailer designers have been saying for years: "You don't *really* want to rough it!"

Most objections to trailer travel are based on ignorance. Others are half-truths. Here are examples:

Towing a trailer is hard on engine and transmission—shortens car life.

After 60,000 miles of towing experience with late-model cars, my response is: Drive sanely, and your car will suffer no adverse effects. I've been towing a trailer for 10 years, and have had no major engine or transmission troubles. The three cars I used were all automatic-shift models.

CONTINUED

Towing a trailer holds the driver down to 45 miles per hour—the legal speed for towing in many states.

Quite true—and four or five million small-boat owners are faced with the same common-sense restriction. However, the difference in time lost is not a real drawback.

I'd say, on the average weekend trip, the extra hour spent towing is more than balanced by the *readiness* of the trailer. Upon reaching your destination, you simply park the car, crawl into the trailer, and hit the sack. No tent to erect, no stumbling in the dark, no worry about reservations.

Trailers cost more than you can save. The new-unit cost of about \$1,200 is difficult, if not impossible, to recover.

This misconception is the worst of all. True, you might make a case against trailers if you compare them with traveling with a tent. After years of experience, however, I'm convinced that the comparison is not valid. Most buyers of camping trailers—or perhaps their wives—are just not tenters.

Logically, you should compare trailer travelers with those who stop at motels and hotels. On a typical vacation day, a family of four (two adults, two children) spends an average of \$30 a day in

motels and restaurants—\$14 for lodging, \$16 for meals.

The trailer-traveling family, however, could get by on about \$8.45 for the day—about \$2 for parking (lodging), \$6 for groceries, and 45 cents for such extras as butane and ice.

I have now kept careful records for three full years, with an average annual vacation of 30 days. You could expect the same results whether the 30 days are taken all at once, in weekends, or divided other ways. Traveling by trailer, I found the costs to be \$253.50 for a year and \$760.50 for three years. Traveling on the motel-restaurant plan would have cost \$900 a year, racking up \$2,700 for three years.

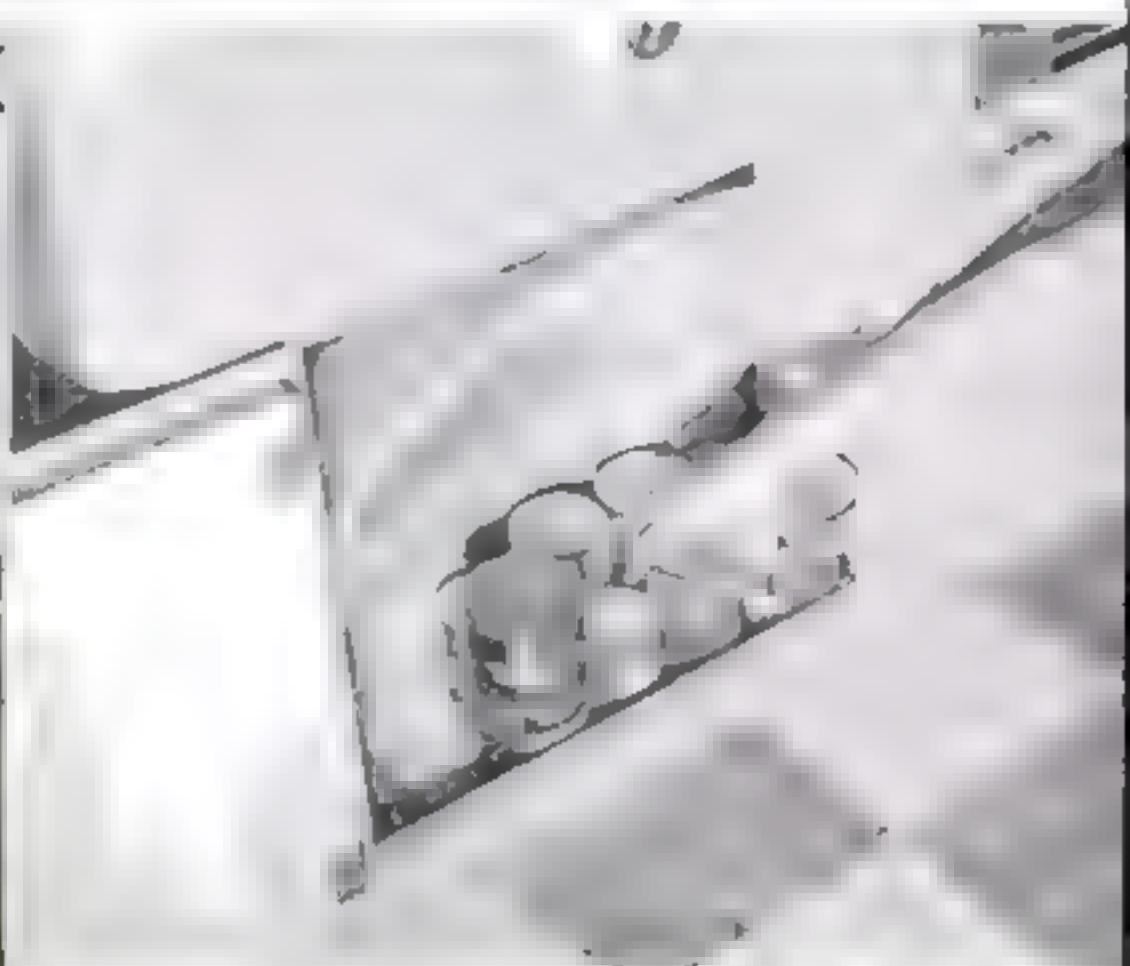
But what about car expense? There can be no denying the increased fuel consumption when you tow a trailer. Mileages are cut about a third. I think this is a fair picture of what happens:

Towing a trailer weighing 1,500 pounds, you can expect to average about 10 miles a gallon. At an average cost of 36 cents a gallon, your fuel costs for 1,000 miles (100 gallons) would be \$36. Without a trailer, you can expect about 15 miles a gallon (conservatively), giving a fuel cost for 1,000 miles (66.7 gallons) of \$24.

With no tent pitching and no motel hunting, trailer travel



YOU CAN'T DO THIS WITH A TENT: Park it, lock it, and take off on side trips knowing your valuables are safe. Sleeping inside, you're safe from weather, insects, and prowling animals.



YOU CARRY YOUR RESTAURANT with you. No cold, greasy food eaten on the run. You pack a full stock of provisions for your favorite meals—and you save the cost of restaurant prices.



THERE'S NO TRAMPING through the woods to find a campsite—it's any clearing off the road.

Or you can stop at one of the many modern trailer parks that offer extra living facilities.

Assuming that the average family drives 4,000 miles for each 30-day vacation, the trailer owner would shell out \$144 for fuel, the man without the trailer \$96. On this basis the extra fuel cost for towing a trailer comes out to \$48 per vacation.

Do trailers need repairs? Along about now, someone is bound to bring up the subject of trailer repair and maintenance. I can only state my own expenses. During a five-year period I have owned three trailers. My only casualties were a faulty butane regulator valve, one flat tire, and assorted burned-out running-light bulbs. The cost was less than \$18.

Trailer tires last an astonishing length of time. With no powered axles to tear off rubber, with no hard cornering to contend with, trailer tires often last 60,000 to 80,000 miles. Tow-car tires, however, may suffer a 25-percent reduced life expectancy.

So the economy of trailer travel is hardly in any jeopardy. Here are my three-year figures:

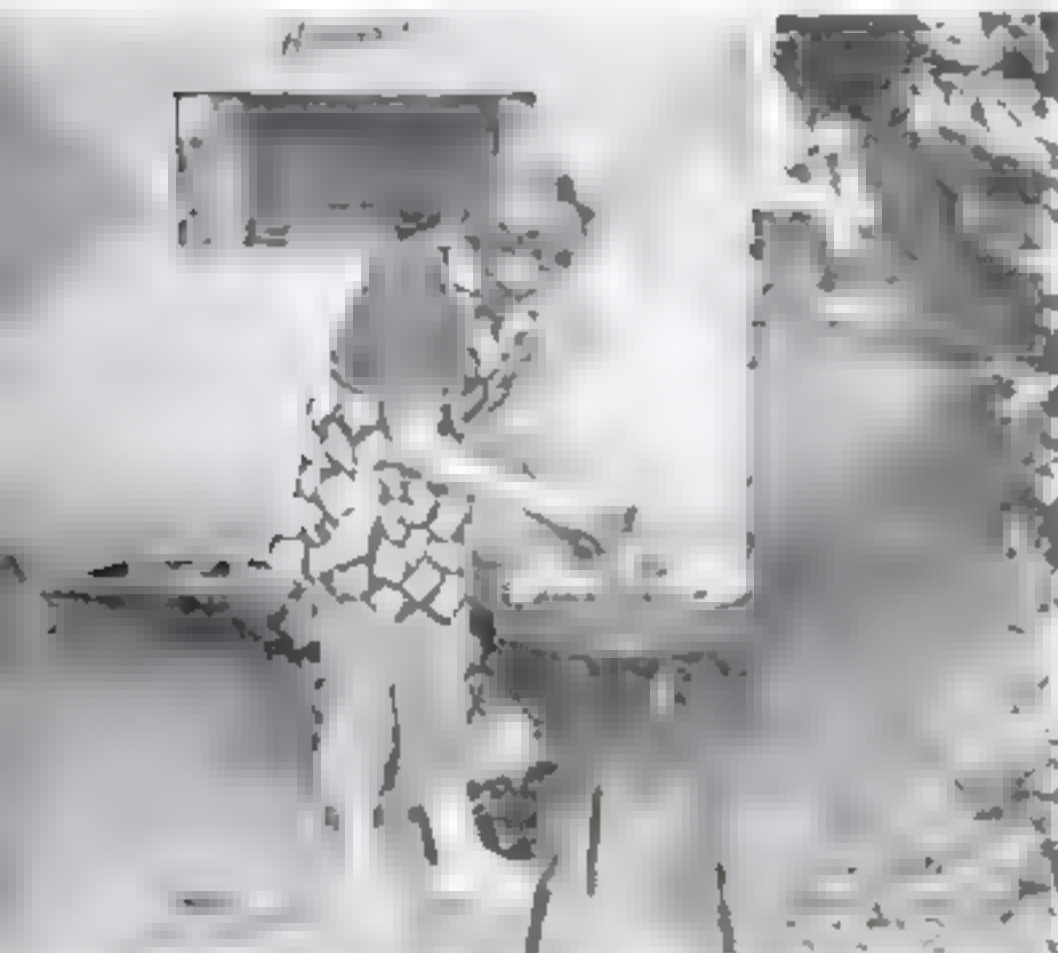
Trailer cost	\$1,200.00
Food, parking fees	760.50
Fuel	432.00
Insurance	150.00
License (Calif.)	81.00
Total	\$2,623.50

The same travel without a trailer would have cost me a total of \$2,988 for three years (\$2,700 for food and lodging, \$288 for fuel).

It's a rolling piggy bank. These figures indicate that the owner of a travel trailer can save \$364.50 in one three-year period—despite the expense of buying the new unit. Beyond that, his three-year-old trailer is still worth about \$600. Subtract this sum from the total three-year expense and what happens to the theory that trailers don't pay their own way? That \$600 is money in the bank.

It is true that the same savings over food and lodging claimed for the trailer can also be gained with tent and folding stove. But what of comfort—that twentieth-century requirement of American families? If tenting costs less, it also gives you less. I am among those happy extenders who now regard collapsible shelters as a sort of twilight zone. It seems necessary to go through this stage to really appreciate your trailer! ■ ■

Is practical—and fun



ALL THE COMFORTS OF HOME—a back-yard barbecue in good weather, a comfortable dining room when it rains. The brazier rides along in the trailer's outside storage bin, out of the way.



Kid-Size Water Skis for \$2

By Hank Clark

THERE'S no need for youngsters to miss out on the fun of water skiing just because commercial skis are expensive and quickly outgrown. The short, boy-size skis shown here can be made with two dollars' worth of lumber and a special sawing trick that eliminates steam-bending and forming. They were made for the eight-year-old you see skimming above and perform with all the speed and precision of store-bought skis.

Select two 48" lengths of $\frac{1}{2}$ "-by-6" dense Philippine mahogany. These should be completely free from splits and warps. The smooth, upward-flaring tips are made by cutting a series of saw slots across the face of each ski starting 5" back from one end. The slots are spaced $\frac{1}{2}$ " apart and are about $\frac{3}{8}$ " deep. Jigsaw a rounded tip on each ski.

Soak the skis in hot water for several hours, then clamp them, one at a time,

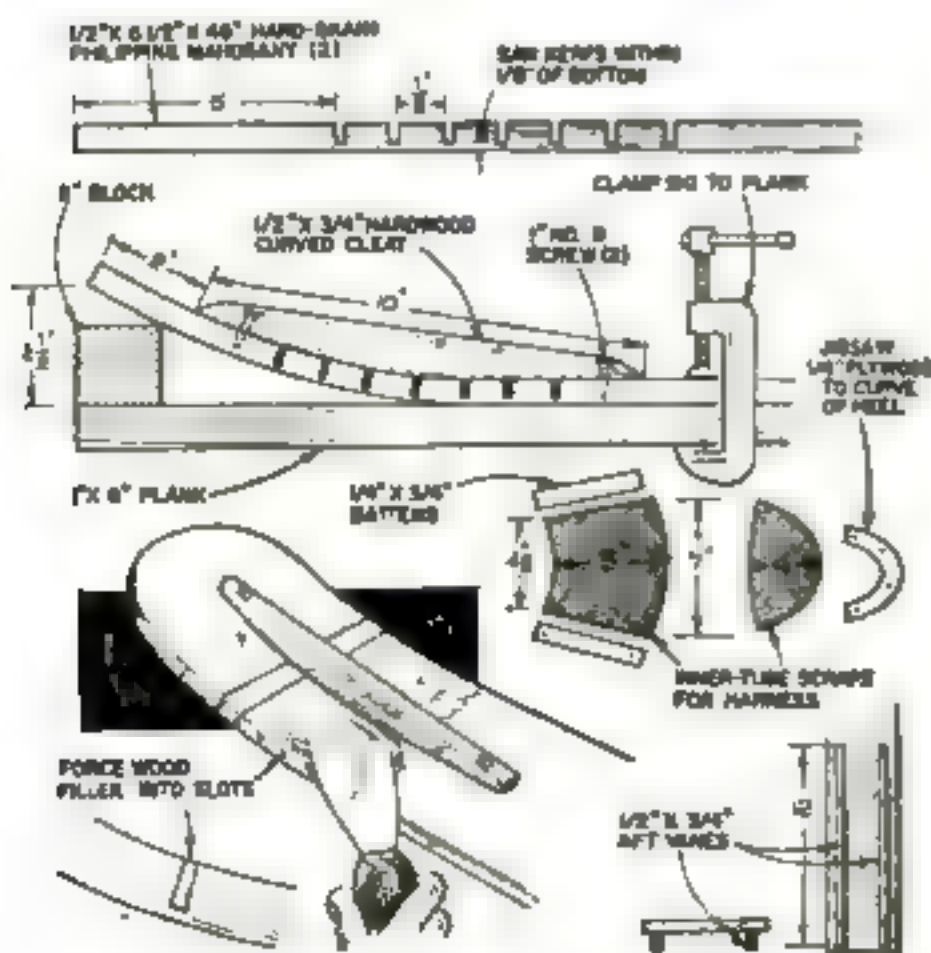


to a board with the tips resting on a 2" block. Tighten the clamp until each tip curves up $2\frac{1}{2}$ " above the board. Cut a cardboard template to match the tip curve and transfer this to two 10" cleats made of $\frac{1}{2}$ " or $\frac{3}{4}$ " hardwood. With the clamp still in place, fasten each cleat on with waterproof glue and screws to hold the curved shape.

The saw slots are patched with waterproof wood filler, and the two after vanes are glued and screwed to the underside of the skis at the rear. These act like keels and give the skis directional stability. The skis are then sanded and varnished.

The rubber foot harnesses can be bought as a kit or made up from scraps of inner tube. Locate the front of each harness 25" from the ski's tip. The toe pockets are clamped on under plywood batten strips screwed to the skis. For the heel pockets, trace the youngster's heel shape onto $\frac{1}{4}$ " plywood and jigsaw two U-shaped cleats.

To get a youngster off to a good start, use a short tow rope—about 18'. Long lines become whippy and unstable. Open the throttle steadily, but without gunning it. Once the skis are waterborne, slack off to the slowest speed that will keep them afloat—too much speed panics a beginner. Keep watching him as you control the boat and let an observer look ahead—just the opposite of ordinary practice. This lets you judge his actions better and coordinate the boat with them. Don't turn on the fancy stuff until he's completely mastered the simple maneuvers. You'll be surprised at how fast he catches on.





CLOSELY SPACED SAW CUTS permit tip of ski to be curved easily after soaking. Slots are $\frac{3}{8}$ " deep and $\frac{1}{2}$ " apart. They can be made with a handsaw if blade is carefully kept level.



HOMEMADE HARNESSSES consist of pieces of inner tube clamped to the skis with thin plywood cleats. Cut the rubber oversize and hit it with the foot in place. Trim off the excess.



CLAMP ONE SIDE OF HARNESS, then pull rubber across foot and mark it for second cleat. Toe and heel pockets should grip foot snugly but be loose enough to get in and out of easily.

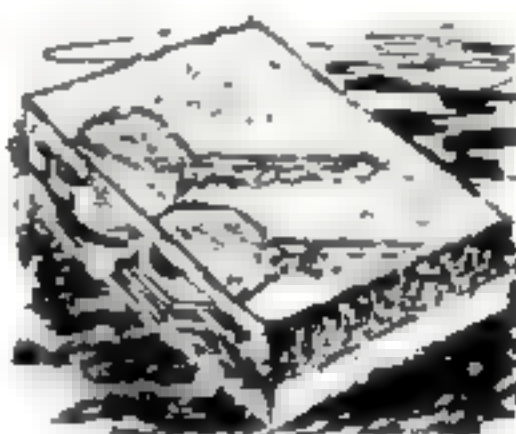
AFTER VANES work like a boat keel, keep skis from skidding. These are 12" lengths of hardwood glued and screwed near the bottom edges flush with the rear ends of the skis.



Boating Tips

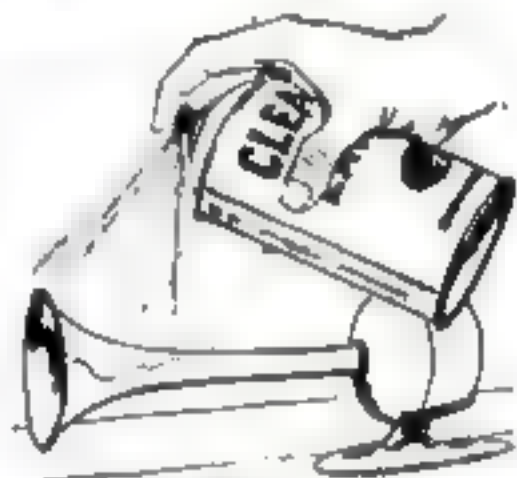


SUN TELEGRAPH: A small mirror is a handy thing to carry along when you go out on the water on a sunny day. Use it to flash signals to friends in another boat or on shore.



KEYS THAT FLOAT: Before going out in a boat, one man always slips his keys into a pocket case made of plastic foam. He cut a slot in the side of a small foam block to take the keys.

BRIGHTWORK: A spray can of clear acrylic plastic is a good investment for boatowners. Spray it on the metal for a hard, weather-proof coating to retain the original brightness.



MOPPING UP: To dry the inside of a boat, it pays to carry a squeeze-type sponge mop with the handle shortened to about 15". This kind of mop has an arm that squeezes the sponge damp-dry without wetting your hands.

NOW LET'S SEE—it looks all here, but is it? Chances are, something important will turn up missing unless you make a careful check with a list.



How to Take Everything on a Camping Trip

EVER start to set up camp miles from home and suddenly discover you forgot the tent? Or brought the air mattresses, but left the pump behind?

The secret of contented camping is remembering to take along *everything*. The necessary items can add up to a whopping list—often more than 100.



YOU'LL HAVE ALL THE COMFORTS of home—like this hammock—if you bring them from home.

Many of them aren't obvious needs—until you find yourself without them.

The check list on the next two pages will serve as both an equipment planner and an automatic memory. It's based on years of experience by expert campers. You may not need all of the items suggested, and you may want to add some special ones of your own, but the basic list will shave hours off your packing and make sure nothing is forgotten.

The list is divided into groups so each member of the family can be responsible for his own share. You can use the two columns of blanks in several ways. You can indicate the items you'll want in the first column, then check them off in the second column as you actually pack them. You can also use the second column to check items back in when you return home, or save it for use on another trip. As you take off, there'll be no more of that haunting I wonder-what-I left-behind-this-time feeling.

**Tear out this sheet for use
as you pack**

Your Own Camping Check List

CAMP SETUP EQUIPMENT

- ___ ___ Tent, poles
- ___ ___ Stakes
- ___ ___ Rope
- ___ ___ Patching tape
- ___ ___ Axe
- ___ ___ Shovel
- ___ ___ Tarp
- ___ ___ Broom
- ___ ___ Dustpan
- ___ ___ Card table
- ___ ___ Lantern and extra
mantle
- ___ ___ White gasoline and
funnel
- ___ ___ Tent warmer and fuel
- ___ ___ Folding chairs
- ___ ___ Hammock and stand
- ___ ___ Car spotlight
- ___ ___ Flashlights and batteries
- ___ ___ Clothespins
- ___ ___ Small tent rug



COOKING EQUIPMENT

- ___ ___ Camp stove
- ___ ___ Icebox
- ___ ___ Pans and lids
- ___ ___ Liquid soap
- ___ ___ Napkins
- ___ ___ Long fork
- ___ ___ Sandwich grill
- ___ ___ Hot pads
- ___ ___ Serving spoons
- ___ ___ Small frying pan
- ___ ___ Large frying pan
- ___ ___ Medium cooking pails
- ___ ___ Collapsible bucket
- ___ ___ Collapsible basin
- ___ ___ Plastic dishpan
- ___ ___ Pancake turner
- ___ ___ Butcher knife
- ___ ___ Paring knife
- ___ ___ Wiener forks
- ___ ___ Dish towels and rags
- ___ ___ Scouring pad
- ___ ___ Thermos
- ___ ___ Can and bottle openers
- ___ ___ Charcoal starter
- ___ ___ Corn popper
- ___ ___ Jars for condiments
- ___ ___ Waterproof matchbox
- ___ ___ Lighter, fuel, flints

TOOL KIT

- ___ ___ Hammer
- ___ ___ Pliers
- ___ ___ Screwdriver
- ___ ___ File
- ___ ___ Nails
- ___ ___ Wire

PHOTO EQUIPMENT

- ___ ___ Cameras
- ___ ___ Auxiliary lenses
- ___ ___ Filters and adaptors
- ___ ___ Light meter
- ___ ___ Film
- ___ ___ Carrying case
- ___ ___ Storage box
- ___ ___ Tripod

SLEEPING EQUIPMENT

- ___ ___ Air mattresses
- ___ ___ Air pump
- ___ ___ Patching material
- ___ ___ Pillows
- ___ ___ Sleeping bags and
covers
- ___ ___ Extra blankets and
carrying bag
- ___ ___ Cot
- ___ ___ Ground cloth

HIKING EQUIPMENT

- ___ ___ Knapsack
- ___ ___ Canteens
- ___ ___ Trail tent
- ___ ___ Compass
- ___ ___ Trail stove
- ___ ___ Mess kits

FISHING TACKLE

- ___ Tackle box (check contents)
- ___ Rods
- ___ Reels
- ___ Landing net
- ___ Bait box
- ___ Hunting knife
- ___ Life jackets
- ___ Waders
- ___
- ___
- ___



PICNIC KIT

- ___ Knives, forks, spoons
- ___ Plates
- ___ Cups and saucers
- ___ Small bowls
- ___ Salt, pepper shakers
- ___ Food cooler
- ___
- ___
- ___
- ___
- ___



MISCELLANEOUS

- ___ Map and case
- ___ First-aid kit (full)
- ___ Snake-bite kit
- ___ Insect repellent
- ___ Insecticide spray
- ___ Binoculars
- ___ Portable radio
- ___ Paper, pencils
- ___ Sports equipment
- ___ Stationery, stamps
- ___ Sewing kit
- ___ Toilet paper



PERSONAL ITEMS*

- ___ Zippered carrying bag
- ___ Underwear
- ___ Socks
- ___ Shoes
- ___ Pajamas
- ___ Sweaters, coats
- ___ Jackets
- ___ Trousers, blue jeans
- ___ Shorts
- ___ Shirts, blouses, dresses
- ___ Hats or caps
- ___ Raincoats and boots
- ___ Swimming suits



*Personal-items list is duplicated for family convenience

PERSONAL ITEMS (continued)

- ___ Toilet kit (case)
- ___ Shaving kit
- ___ Toothbrush and paste
- ___ Lotions and creams
- ___ Comb and brush
- ___ Mirror
- ___ Towels and washcloths
- ___ Soap and soap box
- ___ Reading material
- ___ Laundry bag
- ___ Eyeglasses
- ___ Sunglasses
- ___ Handkerchiefs
- ___
- ___
- ___
- ___
- ___
- ___

PERSONAL ITEMS*

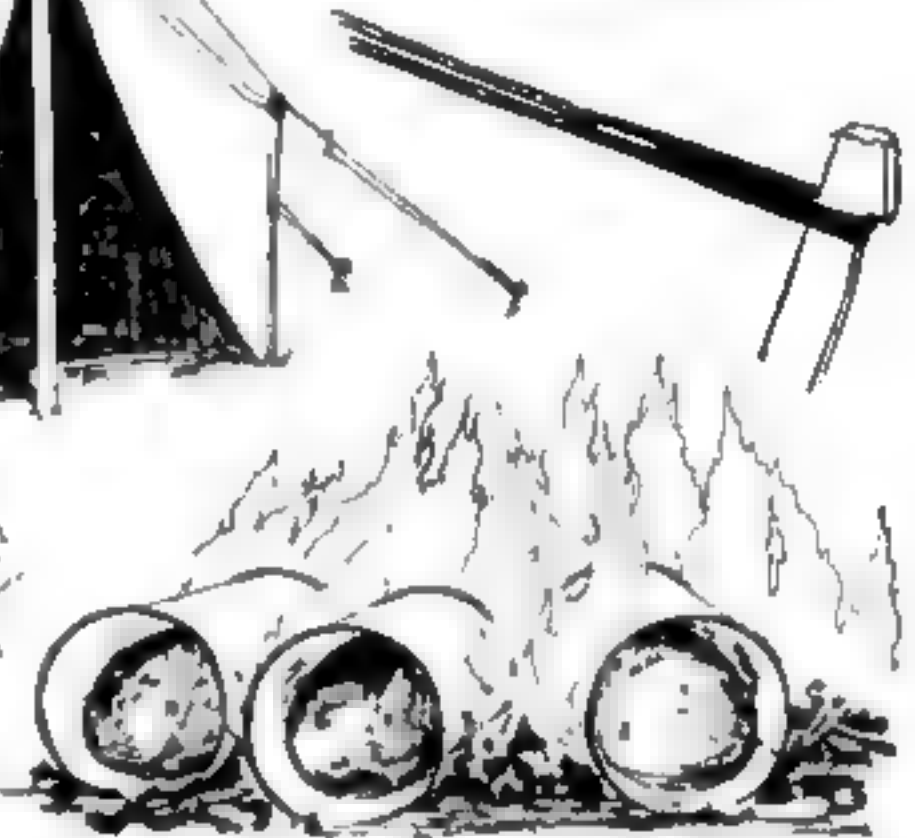
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- ___ Laundry bag
- ___ Eyeglasses
- ___ Sunglasses
- ___ Handkerchiefs
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How to Make a Better Camp

Vacation—Time
Special 

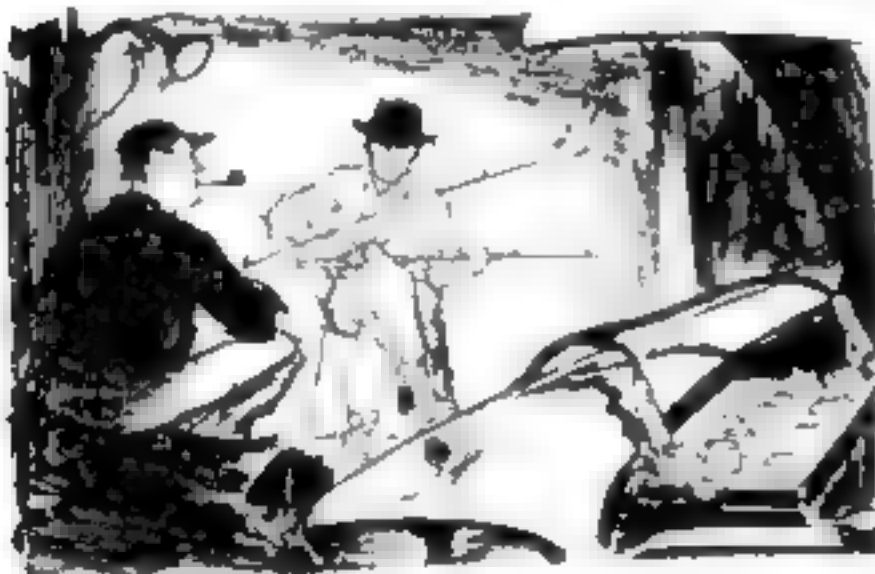


FOR TENT TIE-DOWNS, take along several rubber bands cut from inner tubes. They're easy to hook onto the stakes and they'll give needed play when the tent is buffeted by winds.

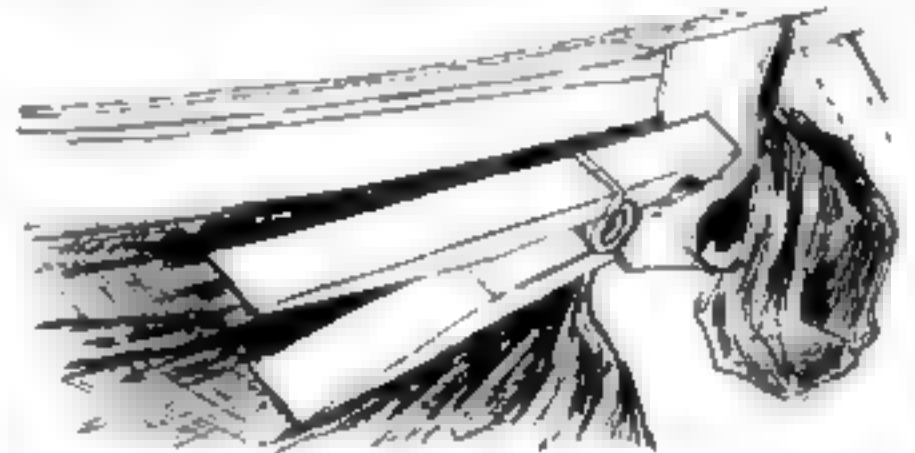


TO ROAST POTATOES in an open fire, put each in a tin can. They won't burn so much.

TO START A FIRE on a windy day, try this: Arrange dry kindling and paper inside a paper bag placed with its mouth away from the wind. Put a match to the paper inside and let the whole thing burn as you pile on wood.

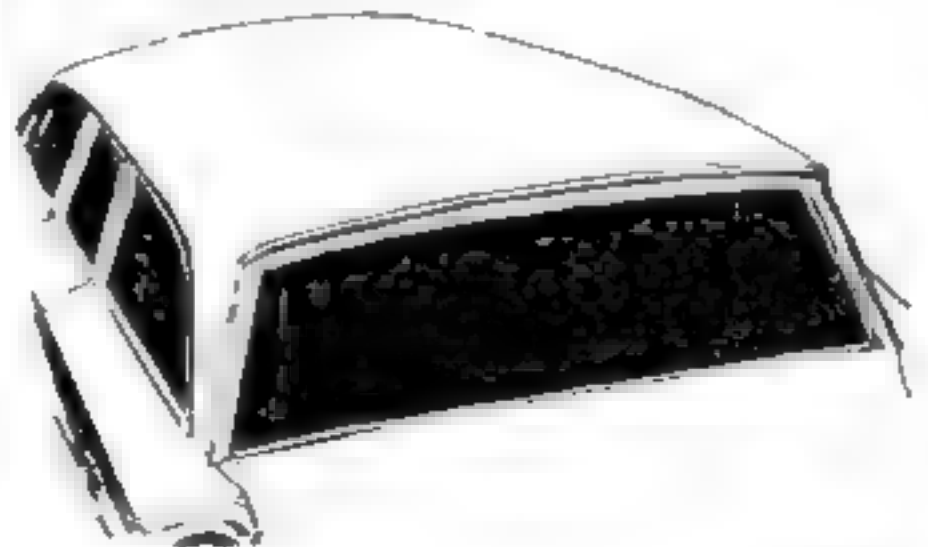


AN EXTENSION CORD will enable you to tap the car battery for light and power while in camp. Fit one end with alligator clips or a cigar-lighter adaptor, the other with a light socket. For light, use a 25-watt, 6- or 12-volt bulb (depending on your car's battery). A spare defroster fan plugged into the extension is handy for coaxing along a reluctant fire—or speeding up a charcoal fire to the point where it's best for cooking meat, a good bed of glowing coals.



SPRING CLOTHESPINs are handy for attaching mosquito netting to the tent flaps at night.

BLACK OUT THE CAR for sleeping by making window shades from black building paper. Pieces of masking tape will hold them in place.





Emergency flares, long used by sailing pros, can make vacation boating safer—and more fun

By F. C. Clark Jr.

Lifesaving Fireworks Afloat

NO BOATMAN in his right mind would venture out without a life jacket and a fire extinguisher aboard. Yet it's surprising how many pleasure skippers overlook a third safety aid—one much less expensive and often more useful: marine distress signals. These signals, usually in the form of flares, are required by law on all commercial pleasure vessels.

Perhaps you figure they aren't for you because you have a small boat and never go very far from shore. Here's the shocker to that:

Most pleasure-boating mishaps occur, not way out in the ocean, but close to shore within plain sight of land and other boats. Many of these tragedies—or just annoying breakdowns—could have been averted if there had been a quick, easy way of calling for help.

Let's suppose, for instance, that:

- You run out of gas in a quiet little cove. You see other boats passing by, but they're beyond hailing range. You wave frantically. They wave back gaily—and pass on. A simple breakdown then becomes a nightmare of waiting for a chance rescue. A \$2 flare would have converted those friendly waves into instant action.

- Or a storm blows up and you start for home, but the engine quits. Because of poor visibility and rising waves, other boats steer clear of you. Without power, you may swamp. Even if you have a radio aboard, an electrical failure could quickly knock it out. You need help fast—or you're a candidate for a Monday-morning headline.

- Or you see your kids out sailing in full view. Suddenly the sail disappears.



DAY-TYPE FLARE gives off stream of bright orange smoke that's visible for miles. An orange flag, included in many flare kits, can be hoisted atop a fish-pole or a paddle to help attract aid.

NIGHT-TYPE FLARE at left burns with a brilliant red flame, does not depend on smoke for visibility. Flares are shown being put through their paces by Tropical Marine Testers, Inc.

Did they capsize or just haul in to make a stop? If they had a flare aboard, you'd know immediately.

Carry a flare—day or night. Distress signals at a hundred times their actual price would sell like hotcakes in any of the situations just listed—if you could buy one. The way to be sure of safe, carefree vacation fun is to have a set of flares on board all the time. They take up practically no stowage space, are waterproof, will burn even in wind and rain, and are packaged to float if the boat should capsize or sink. The cheapest ones cost only a dollar or two.

Two types of flares are available. For daytime use, the top choice is a smoke

flare. This burns for about a minute, giving off a dense orange cloud that hangs together even in strong winds and can be seen for miles. At night, a flame flare is recommended. This depends, not on smoke, but on a brilliant red light to penetrate the darkness. It comes in several sizes that burn from 5 to 15 minutes. Many boatmen prefer the longer-burning types although, of course, they cost a bit more.

It's important to remember that the daytime smoke flare is not effective at night and that the night flare won't work in daylight. You need both types.

How you buy them. Most flares come in kits containing three or four of the same kind or a mixture of both. You can also get a two-way combination flare that can be used either in daylight or at night. You light one end for orange smoke, the other end for a red flame. Some flare kits include other distress aids such as flags,

CONTINUED

Flares come in kits and are lighted without matches

FLARE IS STARTED by stripping off the waterproof wrapper and cap. The cap has a sandpaper top which is then rubbed over the flare's tip to light it, as you would strike a match.

HOLD FLARE AWAY from yourself and others. Pointed outward like this, it can't drop fire on hands or in boat. Note that this flame-type flare isn't effective in daylight.

TYPICAL FLARE KIT contains two red night flares and one day smoke flare in waterproof wrappers. This Falcon kit also includes an orange flag and marker dye. It sells for \$5.95.



whistles, marker dye, and medical supplies.

Flare kits are available at marine-supply stores or can be ordered for you by them. They start at about \$3 for a set of three red night flares—the least expensive—and go on up to \$10 to \$15 for various combinations of flares, flags, and other safety supplies.

Rockets and flare pistols. For the boatman who ventures farther out to sea, there are more powerful distress signals: rockets and the long-famous Very pistols used by military and commercial vessels. These are more expensive than hand-held signals, but shoot flares high up where they can be seen from great distances.

Some rockets project a star-burst type of signal, while others send up a flare that floats down slowly, attached to a parachute. These range from about \$6 for a small one-shot rocket, up to \$45 for a Very pistol that shoots various types of interchangeable shells for day or night use.

Learn how to use them. Hand-held flares are safe when used correctly, but you should see to it that everyone in your crew—even the youngsters—has practiced the procedure at least once.

No matches are needed. The flare is ignited by removing its cap and rubbing it across the tip, like striking a match. Hold the flare high, but not overhead. Keep it pointed out over the side of the boat. Once a youngster has held one of these fiery candles with confidence, he won't be tempted to horseplay.

While the flares are quite waterproof, they should be stowed in a dry place. Tossed in the bilge, they'll eventually soak through and may become useless. And keep them where they can be grabbed quickly in an emergency.

The Coast Guard requires that commercially used flares be discarded every three years and replaced with new ones. While they may last much longer, it's safest to adopt this policy yourself. Old flares can be used to train new crew members or added to your Fourth of July celebration every three years.

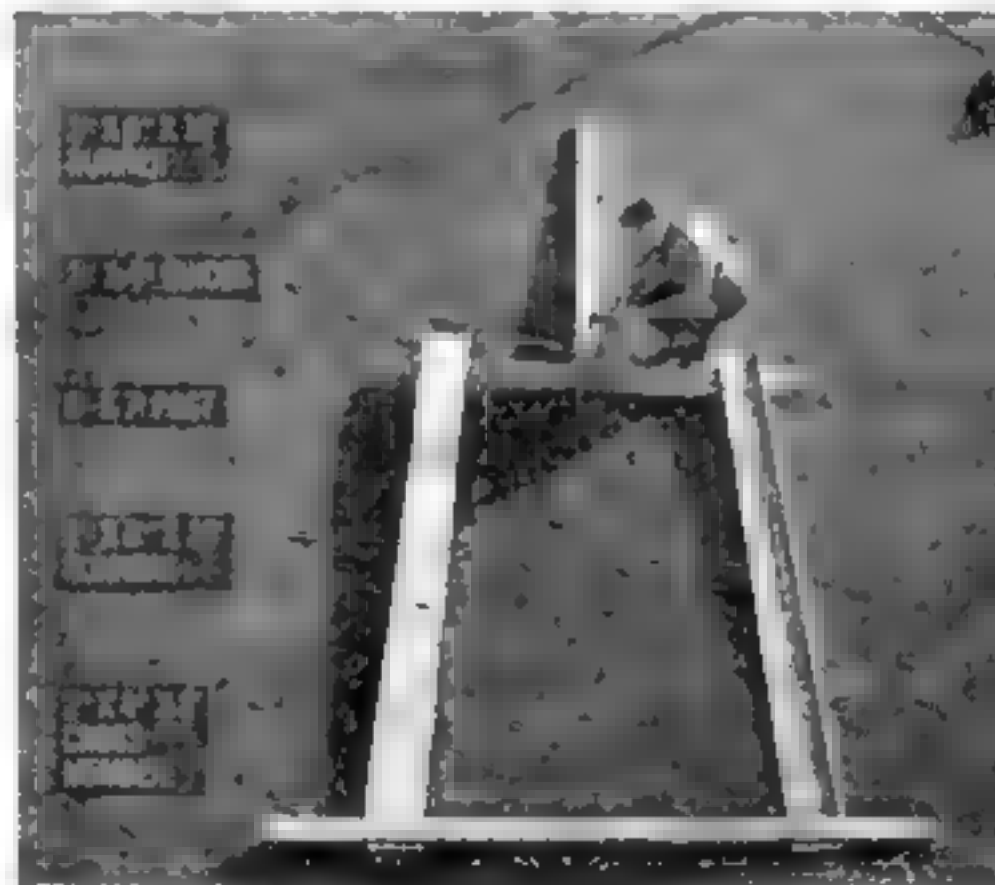
Just remember: Your flares—like your fire extinguisher and life jacket—are best when never needed. Their cost is a small price to pay for the peace of mind and security they give you, even if you never have to fire one up.



Portable Marine Railway

THIS ramp makes a private marine railway at a summer cottage or campsite. It makes it easy for you or the kids to haul a boat out of the water in minutes at the end of a day of fun, or when a sudden storm threatens.

The ramp is made in five sections—two runners for the trailer wheels, one runner for the trailer tongue, and two cross members that tie the ramp together. Nail a one-by-four strip to the outside edge of each two-by-eight wheel runner to keep the trailer wheels from rolling off. Nail



TO ASSEMBLE RAMP, drive bolts into holes drilled in runners and cross members. Wheel runners are spaced to fit wheels of trailer. Tongue runner is centered. Edge guides keep wheels and tongue from wandering off the ramp.



similar strips to both edges of the two-by-six runner to guide the trailer tongue.

Attach the runners to the cross members with galvanized bolts, washers, and nuts. Note that the lower cross member is fastened to the top of the runners to stop the trailer wheels at the end of the ramp. A large rock placed on each overhanging end of the lower cross member keeps the ramp from floating at high tide.

The 10'-long runners and the cross members can be lashed to the trailer frame for transporting them.

To set up the ramp at the water, it's necessary to first launch the boat from the nearest suitable spot. Have someone pilot the boat, while you drive the trailer to the campsite.

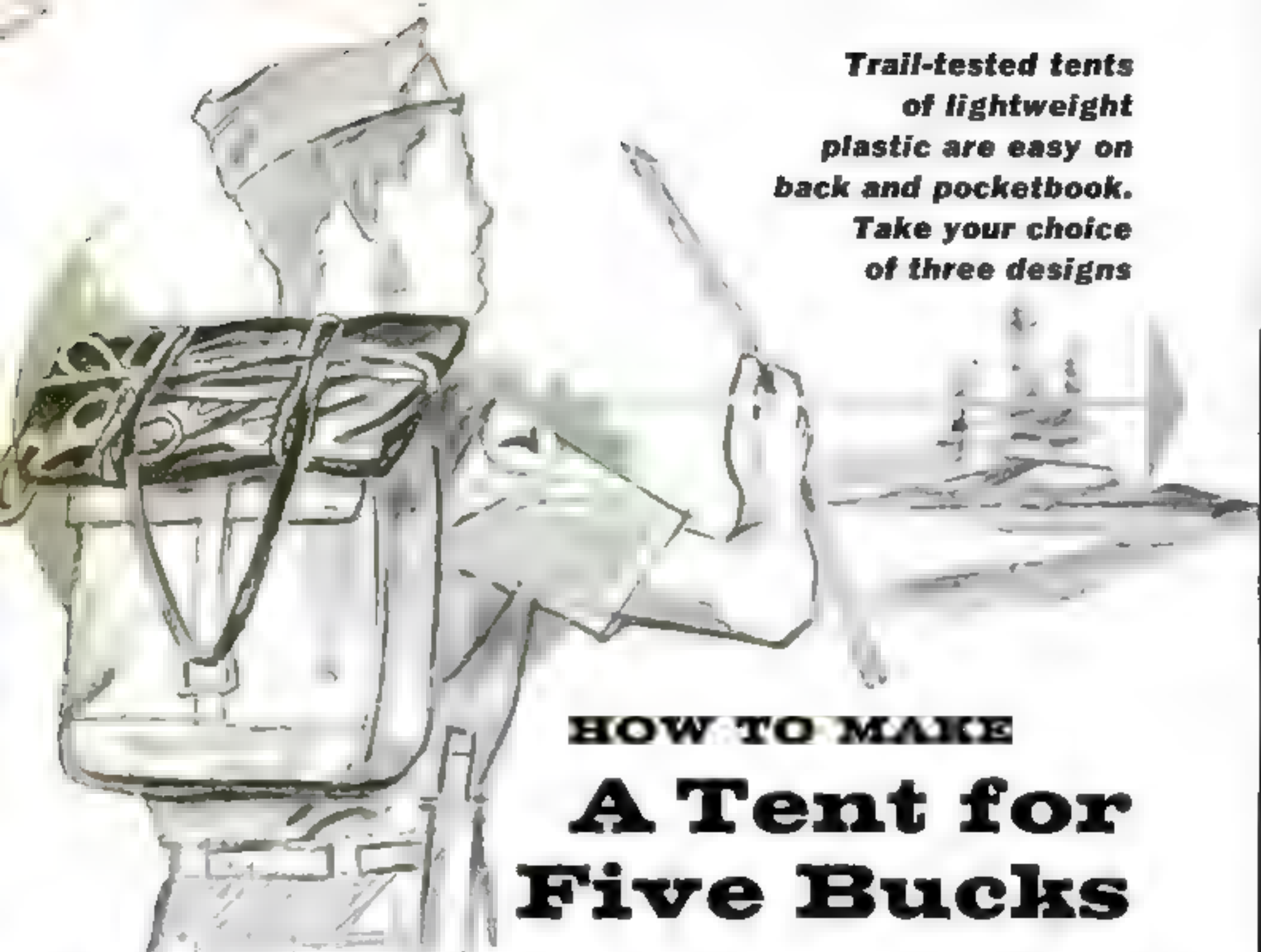
At the water, place the ramp in line with a stout tree. If no tree is convenient, drive a steel anchor stake or "deadman" into the ground in line with the tongue runner. Juggle the empty trailer onto the runners. The photos illustrate the method of hauling the boat.—Gordon Grant, Toronto, Ont.



TO HAUL OUT THE BOAT, roll the trailer to end of ramp and use winch to pull the boat onto the trailer. Snap trailer's safety chain in bow eye to keep the boat from rolling back, then slack off the winch and disconnect the line.



TIE WINCH LINE to a tree or stake driven into the ground ahead of the ramp, and crank the winch to pull trailer and boat up to top of the ramp. A little grease on the tongue runner will make the trailer tongue slide easier.



**Trail-tested tents
of lightweight
plastic are easy on
back and pocketbook.
Take your choice
of three designs**

HOW TO MAKE

A Tent for Five Bucks

By George Thompson and Joe Grow

WHETHER you're hitting the trail into the wilds, portaging toward a secret lake, or merely tossing gear into your car for a rustic camp-out, your tent is usually the heaviest, bulkiest item. It needn't be. Since the problem of a light, compact shelter is particularly acute for wilderness hikers, we set out to develop an inexpensive tent that can be carried on a back pack. After six seasons of testing various designs, we've settled on three that meet all the requirements for one- or two-man trail shelters. The family camper can adapt our principles in designing a larger tent for auto trips.

We've banished weight and bulk—and brought the cost within reach of any budget—by making the tents of vinyl plastic. The plastic we chose is sold as drapery material, in sheets either 36" or

54" wide. It's available in four- to eight-gauge from department stores and major mail-order houses. It's waterproof and resistant to mildew. When exposed to an open flame, it will melt and char—but won't catch fire. Our field tests proved that it withstands the full range of temperatures found in the U.S. without cracking or melting. And, in solid colors, it'll cost between 30 and 40 cents a yard.

This plastic isn't, of course, as strong as canvas or duck. But tents don't need strength across the entire surface. If

the lines of major stress are properly reinforced, a lightweight material can be used. Along these stress lines, attach 1/2"-wide cotton twill tape, using a flexible, waterproof glue that will bond vinyl. Goodyear's Pliobond and U.S. Plywood's Weldwood contact cement are both satis-

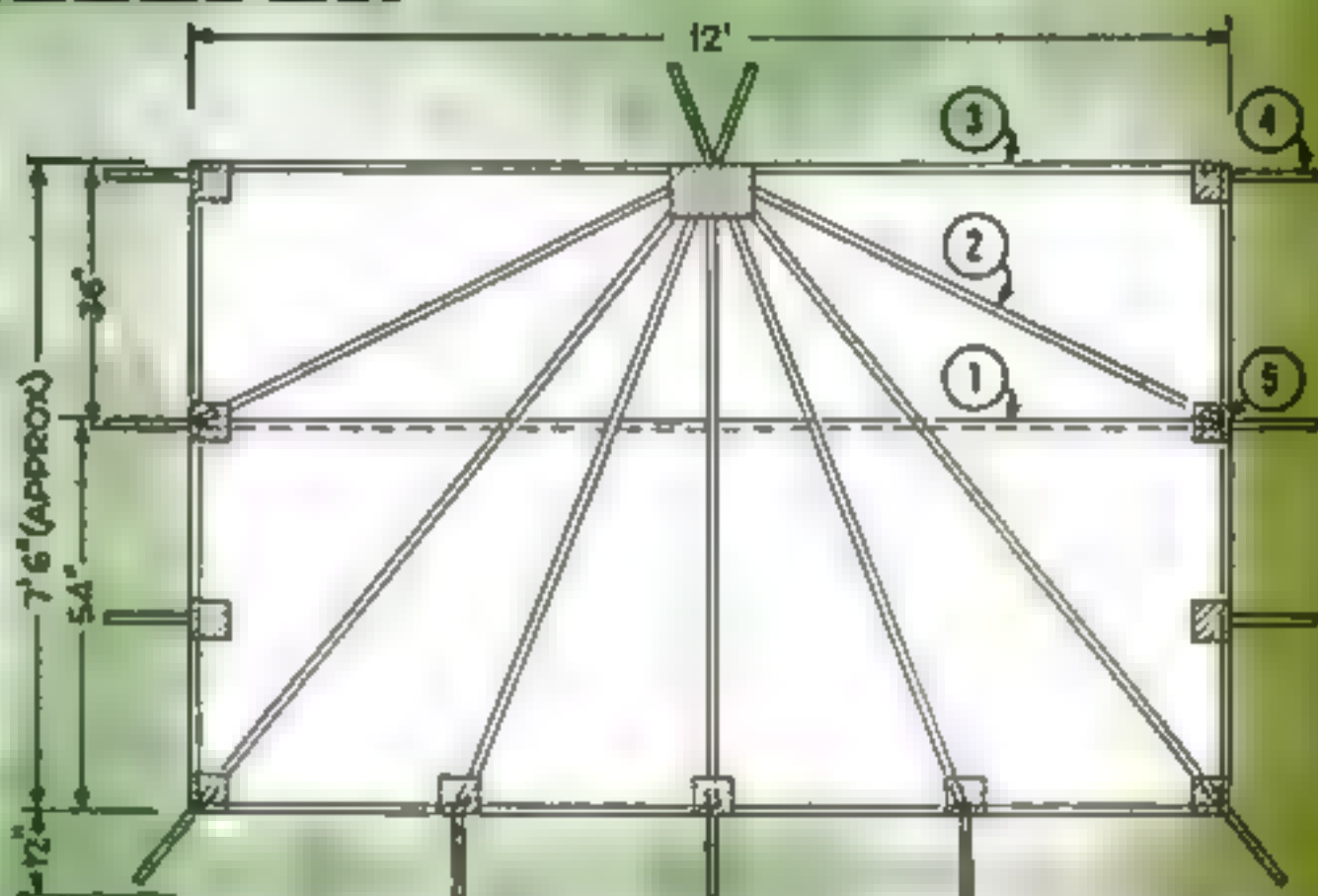




The TRAIL SLEEPER

IT SETS UP IN SECONDS anywhere you can drive a dozen stakes. Next morning, it folds into a four-pound bundle about 3½"-by-6"-by-14". You'll need four yards of each width plastic, plus about 36 yards of twill tape.

1. Glue overlapping seam.
2. Apply stress-line tapes.
3. Apply perimeter tapes on top of stress-tape ends.
4. Apply tie tapes (or rope loops—see sketch farther on).
5. Glue on anchor patches.



factory. These same glues can be used to join plastic sheets in an untaped seam. It's important, however, that you let the glue set for at least 24 hours after the final taping. A test setup is a good idea to check for spots that may need regluing. It's better to locate these in your back yard than at some remote campsite during a thundershower.

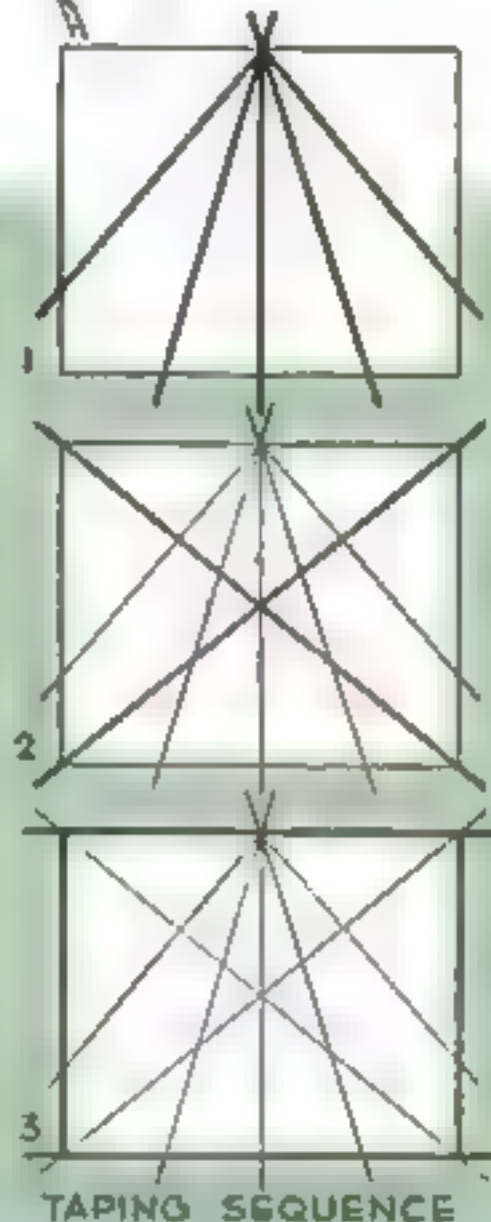
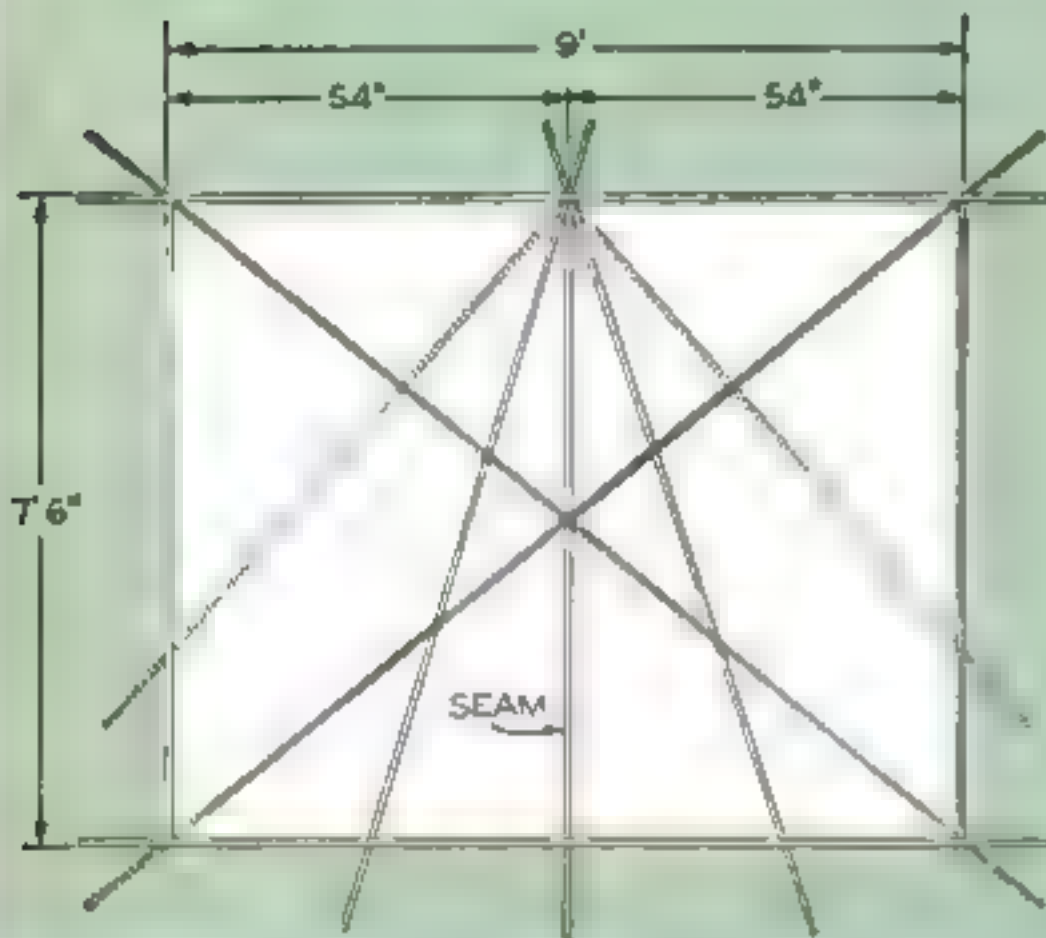
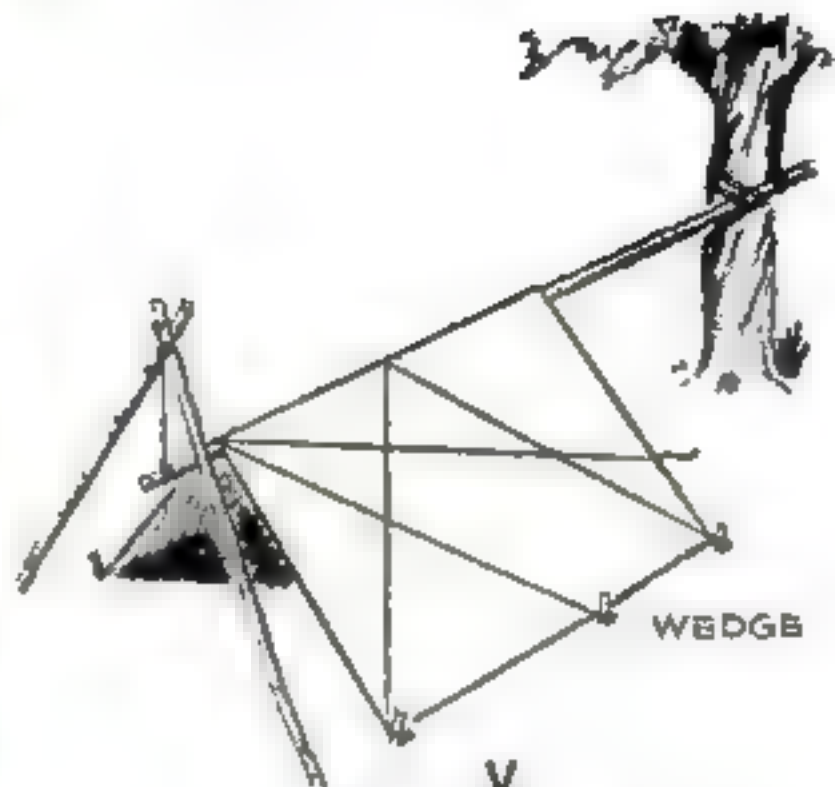
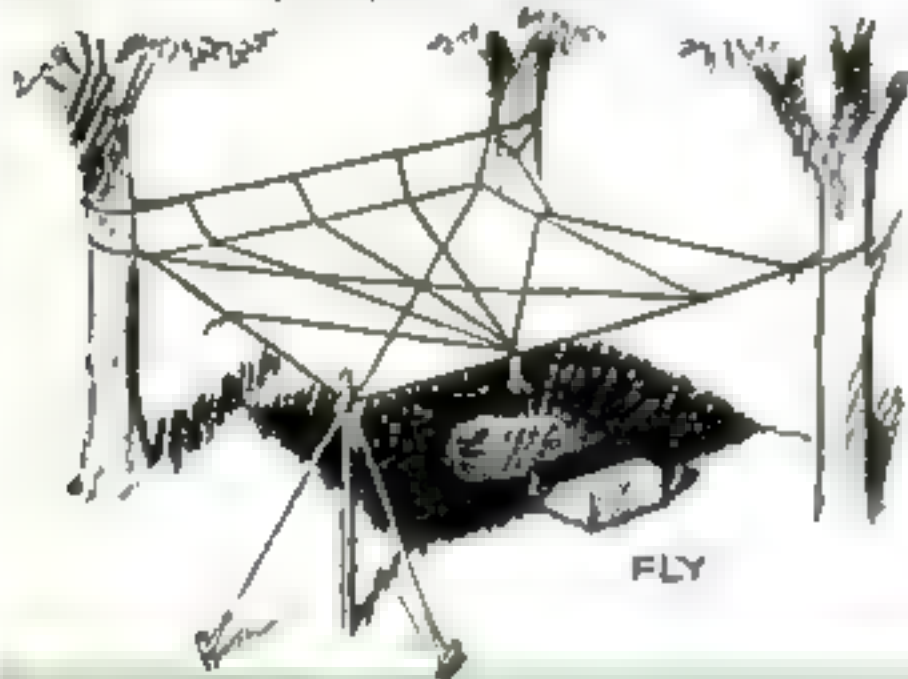
Wilderness tents should be small. There's little need for standing-room shelter on the trail; dressing is done outside—except in a rain. Even under wet or co-ed conditions, struggling with

clothes inside a plastic doghouse is better than lugging a six-foot-high canvas palace over the trail. Each of our tents is only 7½ feet long.

The Trail SLEEPER is intended for the one standard setup (photo above). The center point of the side (upon which the tapes converge) is suspended from a pole or tied to a tree trunk, so that it's at least a yard off the ground. The opposite edge is stretched taut and the two far corners are staked. Next, the two front corners are pulled taut and staked, and finally the intermediate ties or loops. These ties

THE TRAIL UTILITY

VERSATILE VARIATION of the Trail Sleeper, this tent requires two sheets the same width, joined in a lengthwise seam. A modified taping pattern (applied in sequence shown) lets you set it up in two extra ways: fly and wedge.



may be wider twill or loops of plastic clothesline.

Two adults locate their heads near the front center and extend their sleeping bags toward the back corners. Three boys, using shorter sleeping bags, will find the Sleeper just the right size. Total cost of materials was under \$5.

The Trail Utility is a narrower tent, when staked out as described for the Sleeper, but its cross-tapes reinforce corner-to-corner stress lines for additional setups. Since this tent is intended for less-rugged use, the stake ties are merely extensions of the twill tapes, and no

anchor patches are used. The five yards of plastic cost us \$2.

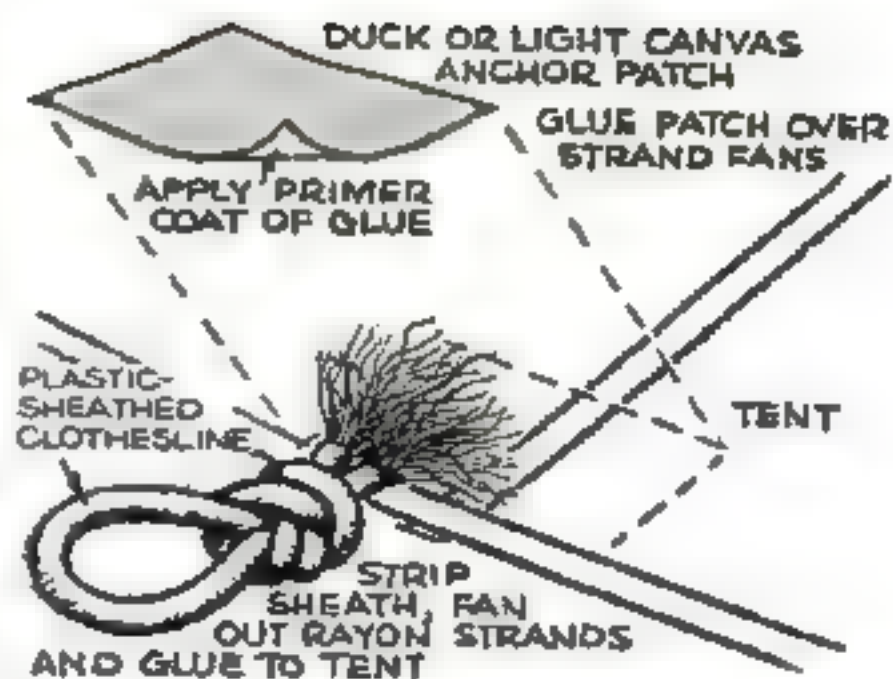
The Trailman, as its name implies, is designed to sleep only one adult. Or it will accommodate two boys, if they overlap their sleeping bags at the feet. Cost of plastic, tape, and glue: about \$3.

None of these tents have built-in ground cloths. The camper should carry a separate sheet of waterproof material to lay under his bedding. Well-designed tents don't need closure flaps on the front openings. A driving rain will enter 10" to 12", but if the ground cloth is folded back, this is no problem.

Most campers have trouble sleeping with mosquitoes whining about their ears. If you're venturing into skeeter country, you can protect yourself by gluing netting, or closely woven cheesecloth, to the tent's front edge. Use netting wide enough so that the bottom edge can be tucked 8" to 10" under the ground cloth when the tent is set up at normal height.

If you don't mind extra weight, you can seal the other three edges by gluing on a sod cloth. This is just a 6"-to-8" band of plastic that folds inside when the tent is erected. The ground cloth is then laid to overlap it. As with the netting, it's a good idea to anchor this overlap with shoes, flashlights, and other small items of equipment.

Handle with care. Plastic tents, because of the way the material holds a crease, never look quite as trim as cloth shelters. Don't try to pull all the wrinkles out of a plastic tent when you set it up. Fold—don't roll—your tent, and squeeze out all air during the folding. Plan the folds so as not to trap air in a pocket.

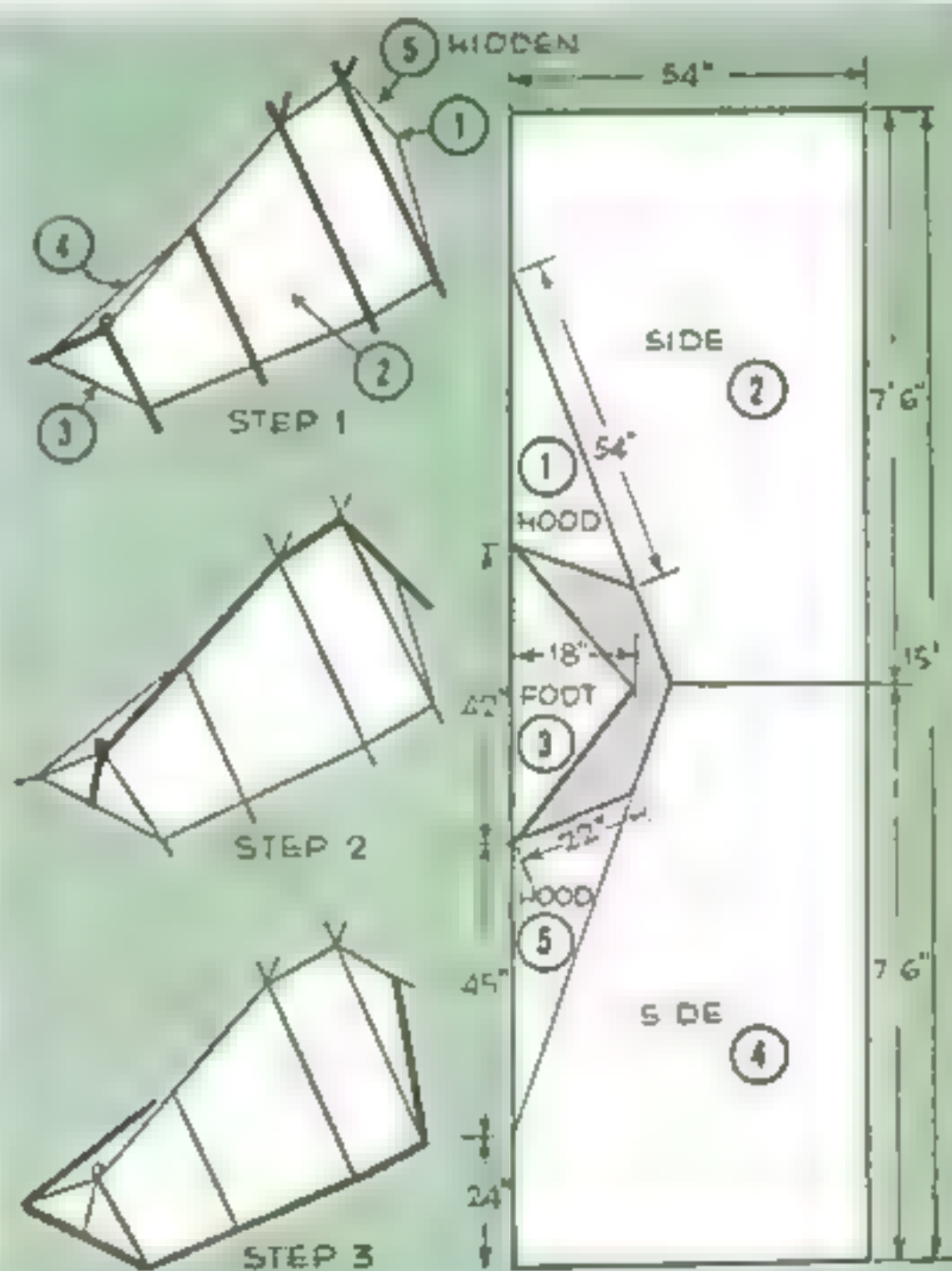
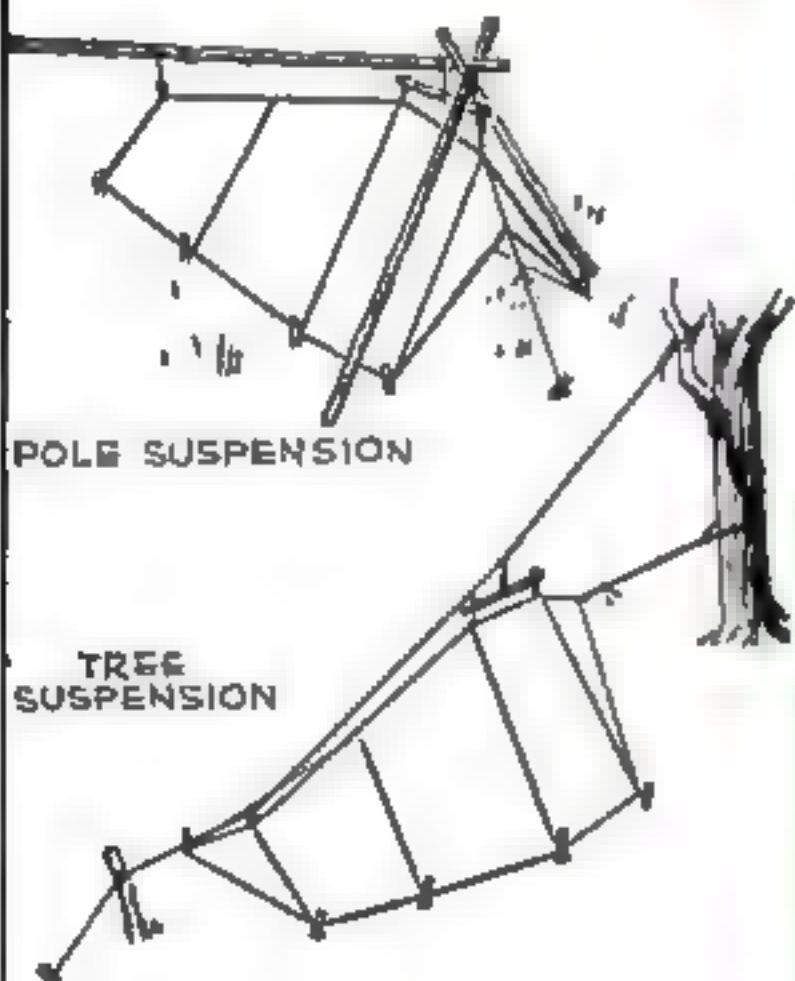


FOR RUGGED TRAIL USE, tents can have separately applied stake loops, instead of extensions of the tapes. Let the primer coat set before gluing the patch over the strands.

Though the plastic withstands abuse from the elements, it can, of course, be damaged by carelessly packed knives, flying campfire sparks—or by being dragged across sharp rocks. Mending patches may be of the same material as anchor patches, or a square of plastic may be used, omitting the primer coat of glue. ■■

The TRAILSMAN

SUSPENSION-TYPE TENT needs more seaming than the other two. Its five panels can be cut from five yards of plastic with little waste. Mark off each edge, lay out triangle 3 and use its short side to mark off rear height of sides 2 and 4.



Short Cuts and Tips

FROM PS READERS

Beam Scale Balances Cutter Knives

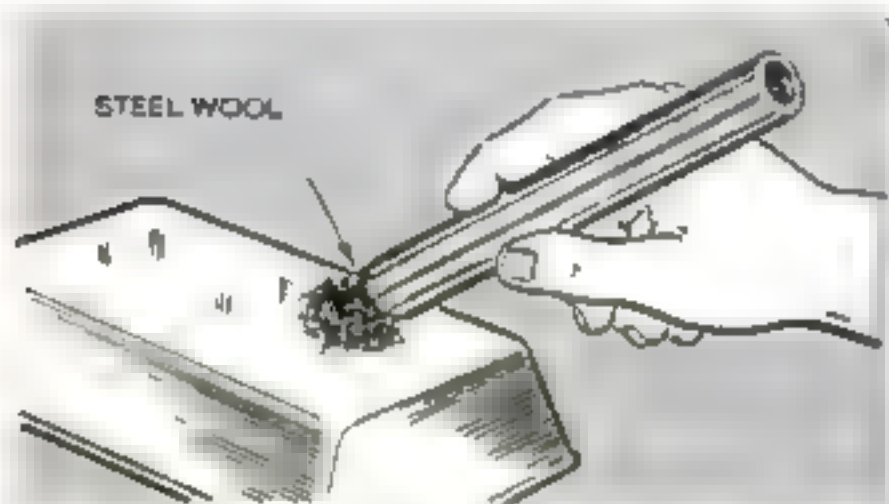
JOINTER heads and molding cutters can be kept free of dangerous vibration by balancing the knives against each other when you sharpen them.

A simple beam scale like the one illustrated will help maintain the balance of these high-speed tools. A clock hand screwed to the center of the beam serves as an indicator to show when the beam is level.

After grinding the knives, place them



on the scale to check the weight of each against the others. If one knife outweighs the others, grind off a bit more until it balances just right.—*Andrew J. Poggi, South Norwalk, Conn.*



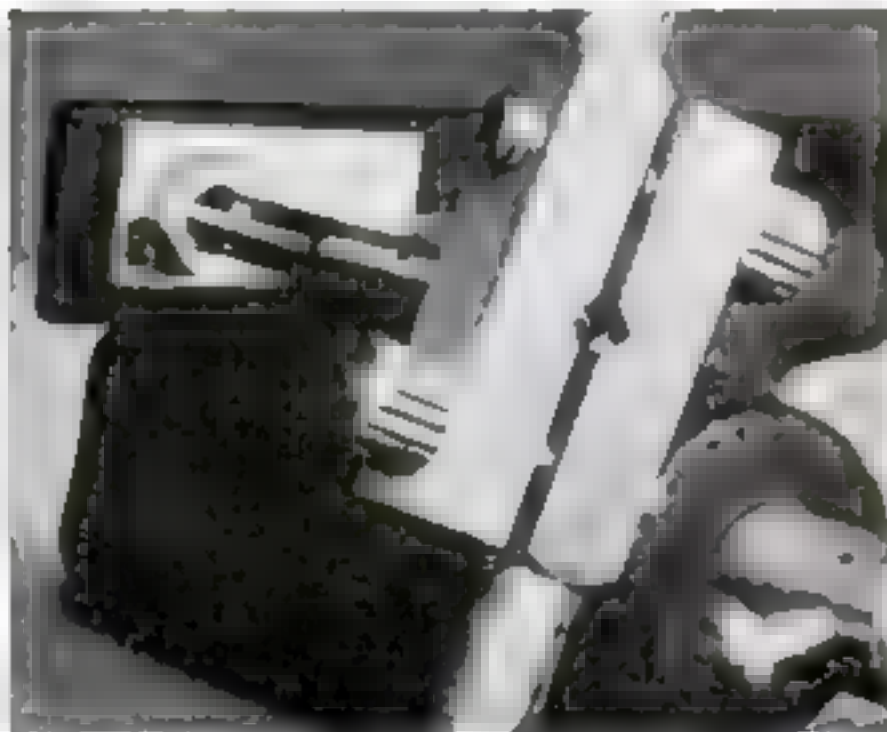
Handle for Steel Wool

A SHORT length of garden hose can serve as a handle and save your fingers from steel slivers when you're scouring with a steel-wool pad. Pack the wool into the hose and let some hang out at one end. As it wears away, use a pencil to push more out of the end. When the supply is exhausted, refill the piece of hose.—*Francis R. Young, Jackson, Mich.*



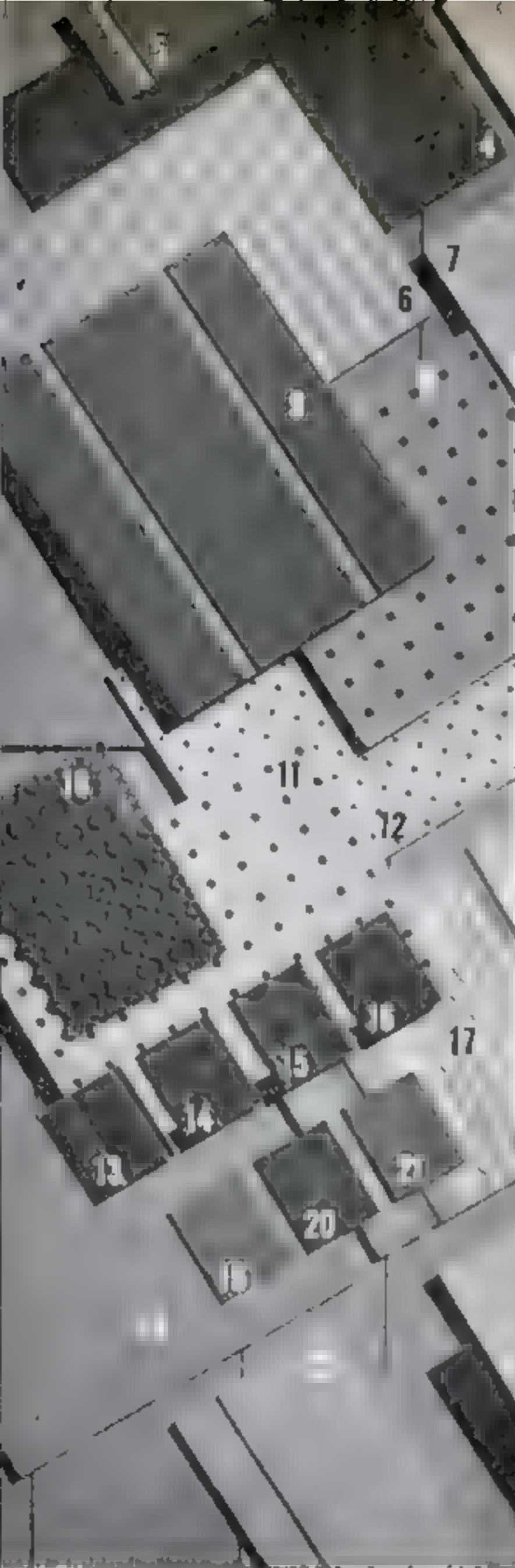
Air Cleans Out Concrete Chips

BORING holes in concrete for masonry anchors leaves dust and chippings that are hard to remove and may jam the anchors. I've found that a tire pump fitted with a football-inflating needle will quickly blast the holes clean of unwanted chips.—*John H. Christensen, Fresno, Calif.*



Nut Guides Tap Straight

You can make sure that a tap starts straight by running it through a nut having the same thread as the tap. Solder the nut first over a hole in a scrap of flat metal, then use a clamp or vise to hold the nut rigidly over the hole to be tapped.—*O. A. Nelson, Seattle.*

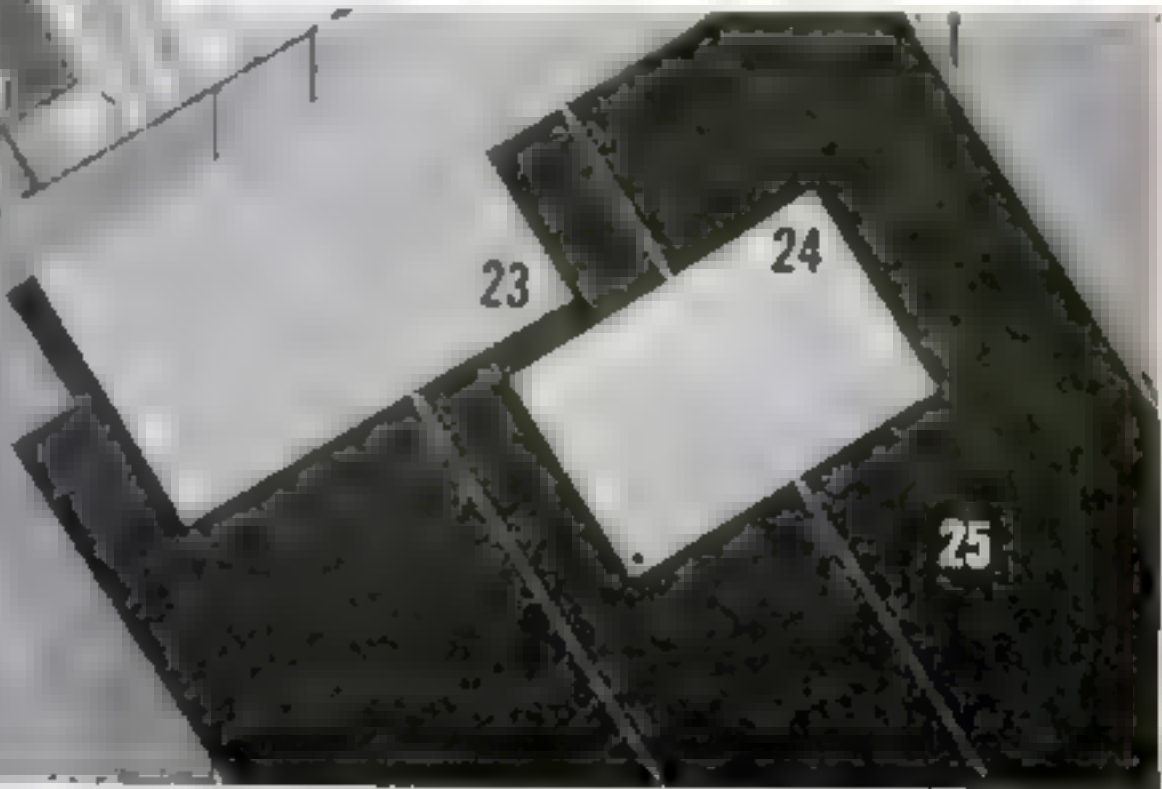


materials
file

The Many Kinds of Hardboard

Plain, colored, textured, curved, flat, indoor, outdoor—here's how to choose the right one for the job

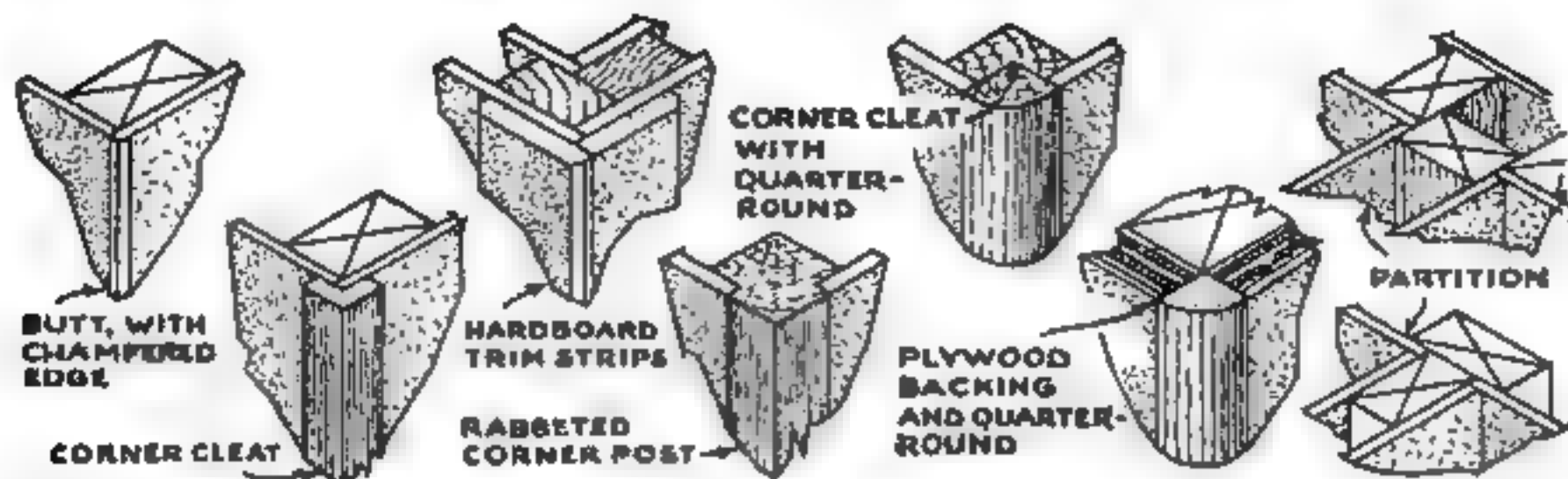
THIS year, American manufacturers will turn out enough hardboard to form a 4'-wide strip $\frac{1}{8}$ " thick reaching $3\frac{1}{2}$ times around the world. Slice this strip into standard 8' lengths and there'd



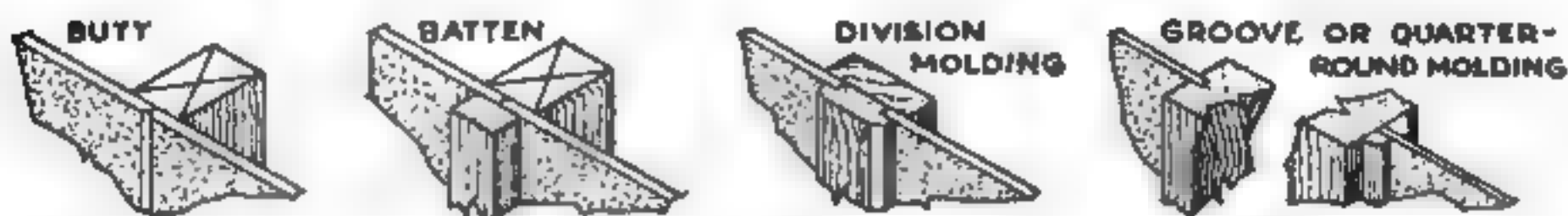
**What the
types shown
above are:**

1. corrugated; 2. grooved; 3. matted; 4. patterned; 5. 16" x 16" x 1/8" thick; 6. matted; 7. matted; 8. matted; 9. matted; 10. gillwork; 11. grooved; 12. basket weave; 13. diamond patterned; 14. basket weave; 15. diamond patterned; 16. basket weave; 17. diamond patterned; 18. basket weave; 19. diamond patterned; 20. basket weave; 21. diamond patterned; 22. basket weave; 23. diamond patterned; 24. basket weave; 25. diamond patterned.

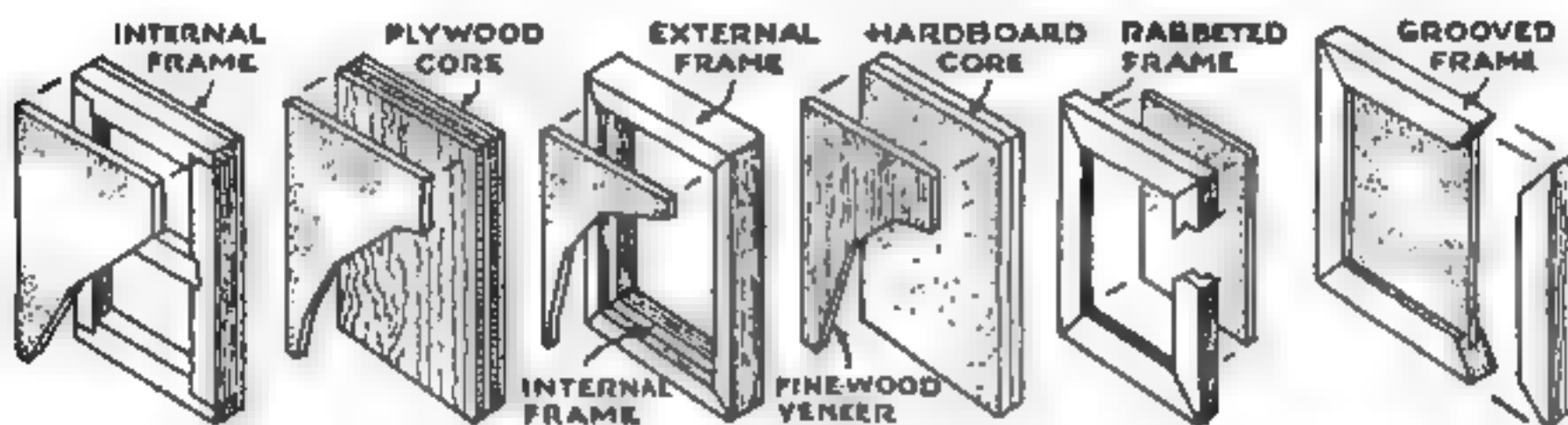
Different framing methods adapt hardboard to any job



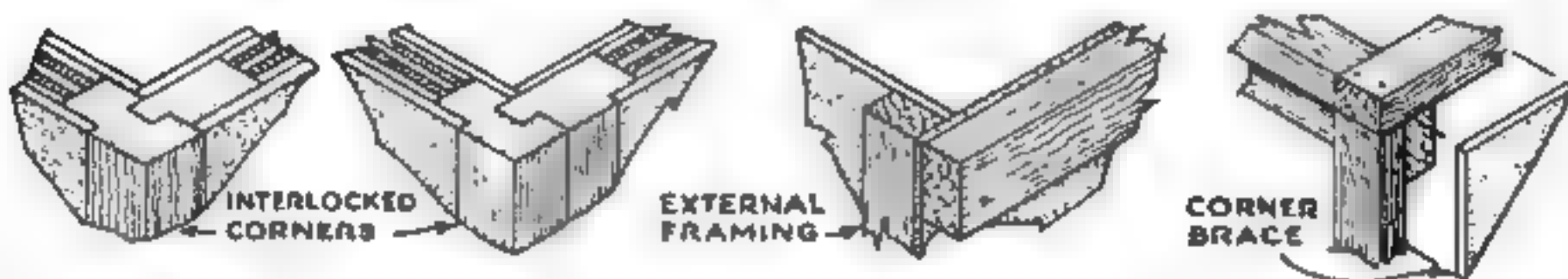
WALL AND PARTITION CORNERS



CONTINUOUS-WALL JOINTS



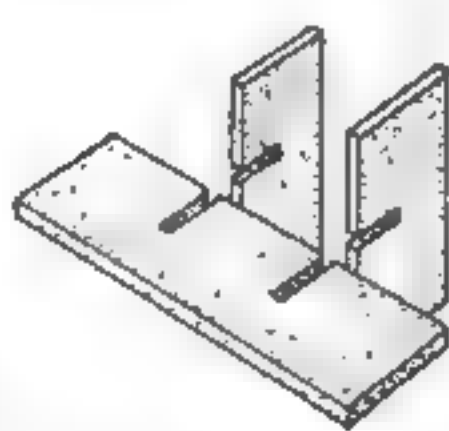
DOOR CONSTRUCTION



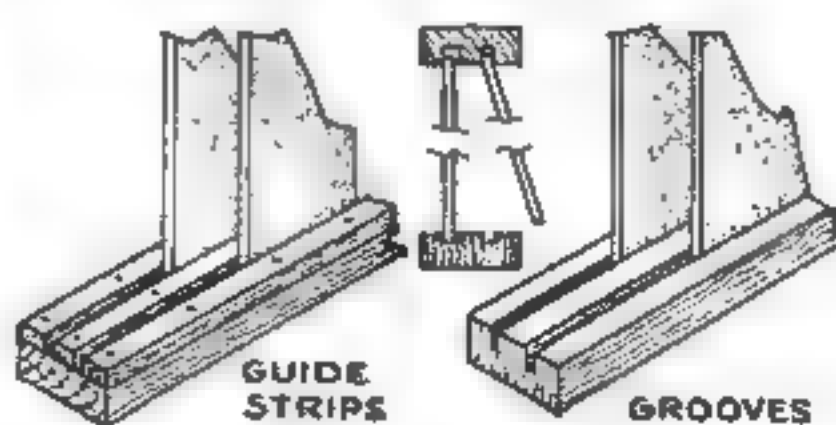
DIVIDERS



"EGG-CRATE" CUBBY HOLES



SLIDING-DOOR GUIDES



CABINET AND BUILT-IN WORK

be a panel for every family in the United States.

Almost a sixth of this 2,000,000,000 square feet of hardboard will be used for home improvements. That's where you come in. If you've never worked with hardboard, you're making a lot of jobs tougher, less attractive, and more expensive than they should be.

If you have used hardboard, you've likely found it easy to handle, strong, and durable. But you still may not know what a wide variety of types you can buy today, each suited to special building or decorating needs. You also may not be getting the best results from a material that's remarkably cooperative when you use it right—and not so obliging when you don't.

What hardboard is. For 20 years or so, starting back in 1924, hardboard was produced by a single company and, as a result, has become known to many buyers as "masonite." Today, hardboard is made by a dozen or more companies and is known by many trade names.

Whatever the brand, all of this versatile material basically is made the same way. Wood is first slashed into chips. The chips are reduced to tiny fibers. These are shuffled about to form a thick criss-crossed matting, or felt. The felt is heated to soften the natural glue surrounding each fiber, and squeezed into sheets under thousands of pounds of pressure. The result: building panels that have these advantages over natural wood:

- **Large sizes.** Four-by-eight-foot panels are standard, but you can buy sheets up to 16' long on special order.

- **Uniform thickness.** A mill can press hardboard to any gauge almost as accurately as sheet steel. The most common thicknesses are $\frac{1}{8}$ ", $\frac{3}{16}$ ", and $\frac{1}{4}$ ". Special thicknesses include $\frac{1}{10}$ ", $\frac{5}{16}$ ", and .215". One-tenth is ideal for light work involving minimum-radius bends, $\frac{3}{16}$ " for heavy-duty cabinetwork, and .215" as an underlayment for tile.

- **Uniform texture.** There's no grain to check, splinter, split, or lift. There are no troublesome knots. Bending is easy in all directions. There's no warpage. Cutting is a breeze. So is finishing.

- **Tempered toughness.** Standard hardboard is compressed to produce strong panels that are fine for interior work where dampness isn't a problem.

By immersing sheets in oil and giving them a further squeeze at very high temperatures, manufacturers turn out the even-tougher product called tempered hardboard.

- **Weather resistance.** In addition to beefing up the panels, tempering has brought hardboard outdoors as a highly water-resistant construction material. It's so impervious to moisture that masons use it to make salvageable concrete forms. In carpentry, it's a natural for exterior panel siding, clapboards, shutters, and fences.

- **High strength-to-weight ratio.** A properly designed assembly of hardboard and light framing is both lighter and more rigid than a conventional wood assembly of the same size. Engineers who developed the first version of this modern building method for the aircraft industry have a name for it—they call it "stressed-skin" construction.

- **Low cost.** Because of its structural strength, hardboard saves you money by permitting the use of thin panels. Depending on the type you pick, it's usually considerably less expensive than other comparable forms of paneling.

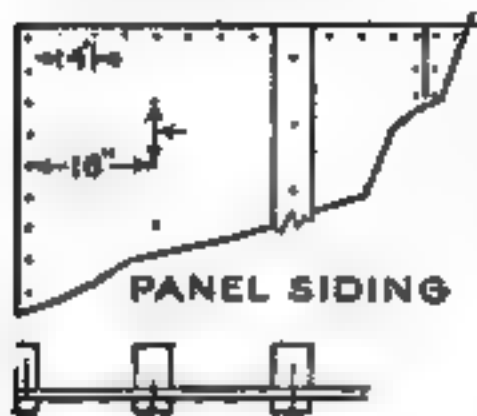
How about appearance? There was a time when hardboard hid in attic rooms and behind cheap furniture. Now architects and decorators are using it for "Sunday parlor" walls. They give it a coat of clear finish or paint and set it off with matching or contrasting trim.

Hardboard is particularly easy to finish because it's completely free from the lifted grain that mars many wood and plywood applications. Hardboard should be primed before finish coats go on. Where a surface has been scratched or broken, it should be pre-primed with a good linseed-oil-base product, and then sanded lightly.

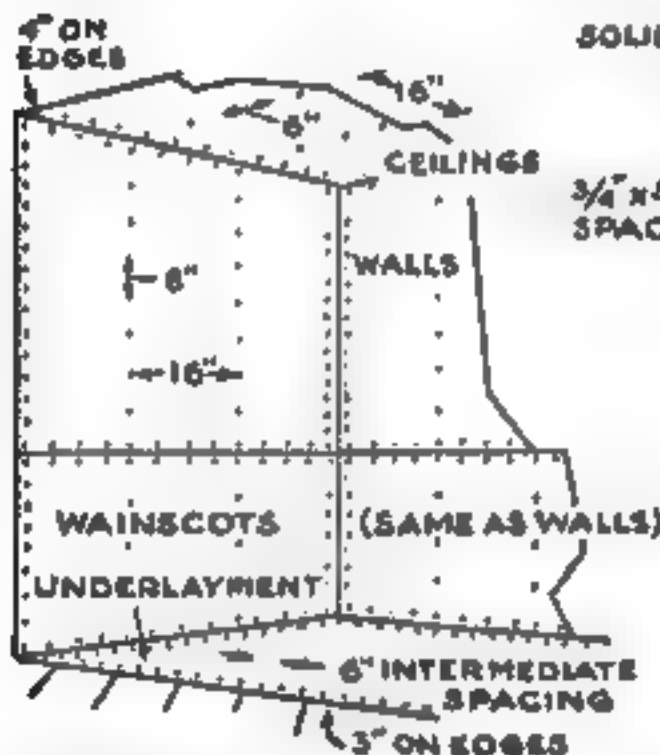
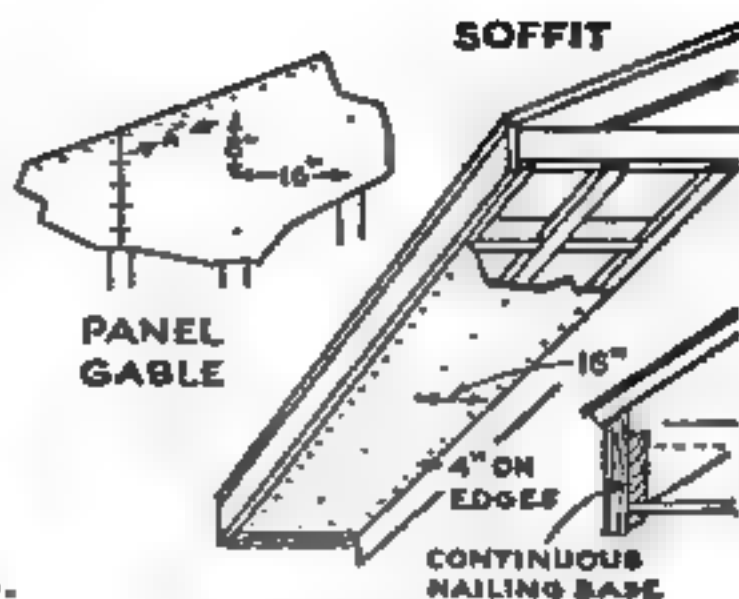
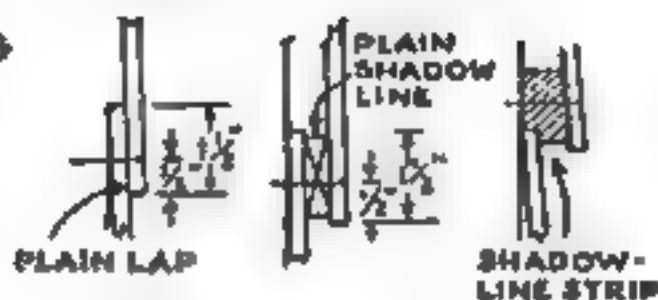
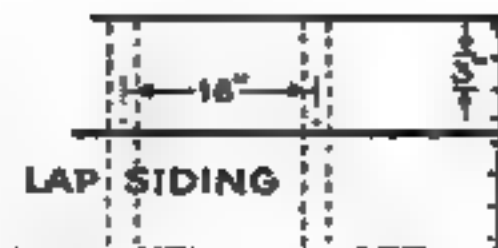
Manufacturers also offer a wide choice of specially surfaced panels. There's a "sculptured" line, embossed on one side to produce shadow-accented patterns: basket weave, four-faceted diamonds, ribs, striations, or louvers. Bright, baked-on enamels are applied to other panels. These come in solid colors in both panels and small square tiles.

Modern designs and reproductions of delicately veined marble and costly fine-woods are another face-lifting treatment. Coated with tough plastic after printing,

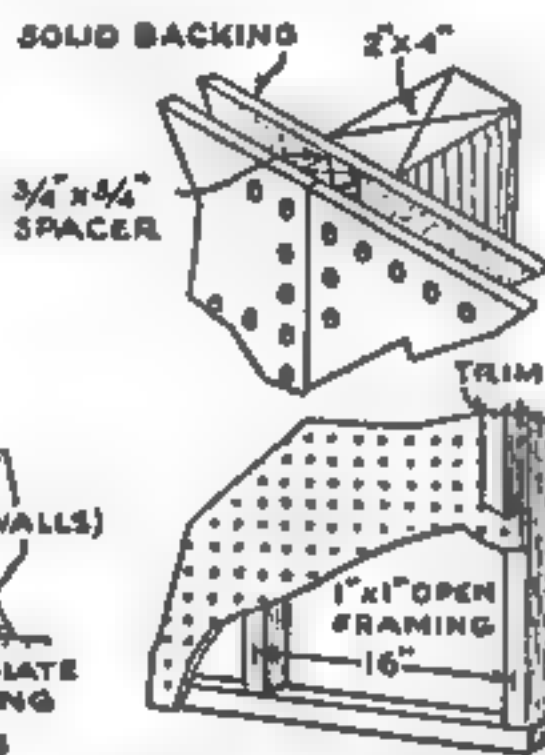
NAIL SPACING



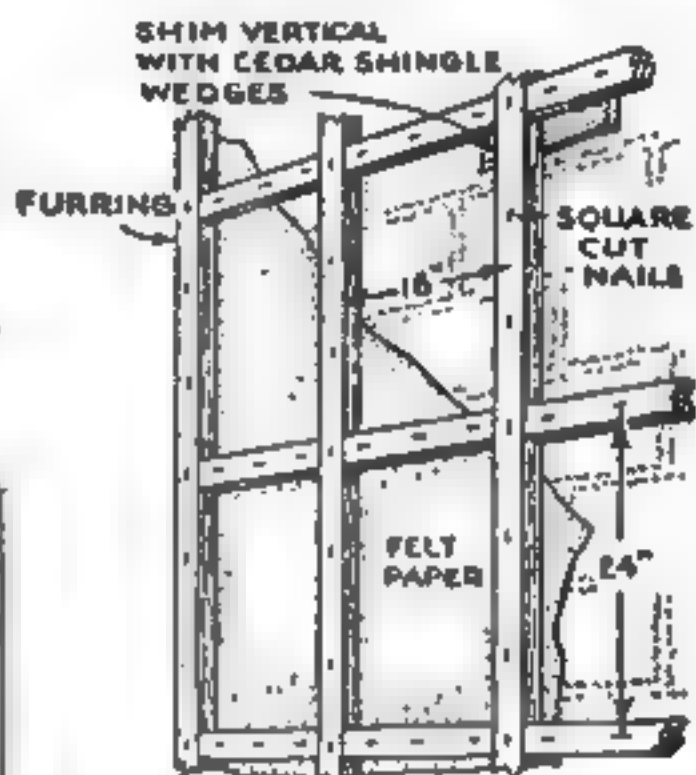
EXTERIOR SURFACING



INTERIOR SURFACING



BACKING PERFORATED HARDBOARD PANELS



APPLYING PANELS TO MASONRY WALLS

Which Nails to Use for What

Interior walls, ceilings and soffits	1 1/4" or 1 1/2" casing or finishing; 1 1/4" box, flathead ring-groove, or annular-thread*
Cabinet surfacing	Finishing or annular-thread of maximum length permitted by framing or core thickness*
Underlayment	1 1/4" flathead drive-screw, ring-groove, or annular-thread
Finish flooring	1 1/4" coated casing
Protected exteriors	1 3/4" box, siding, or sinker
Lap and panel siding	2" galvanized siding or box where wood or plywood sheathing is used; 2 1/2" over other types of sheathing; 3" where nails are used through shadow strips
Concrete forms	1 1/4" blue lath nails

*Or use adhesive following hardboard manufacturer's recommendations

the first two may be bought in both sheets and squares; the simulated wood in panels or planks either smooth-faced or grooved.

You can get matching hardboard trim in base, cap, casing, facing, division, and shoe types. Or you can use aluminum moldings that are polished, colored, marbled, or wood-grained. A comparative newcomer in metal trim is a vertical lock strip with two tongues. When the grooved edges of the panels on either side are slipped over the tongues, only a narrow center section shows. This is perforated to take hangers that support shelves, racks, and other fixtures.

Perforated hardboard. It was a big day for hardboard when neatly spaced holes were first punched through it. The convenience of this for storing garden and shop tools, sports equipment, toys, and knickknacks has made it one of the hottest items in the industry. It also provides ventilation for storage cabinets and hi-fi

rigs, and forms partitions between attic bedrooms and exhaust fans.

Stylists have latched onto it to relieve solid wall areas. Used as paneling for valances and room dividers, it comes alive with natural and artificial back-lighting. You can now buy perforated hardboard with the holes aligned the width and length of the panel, perforating the panel on the bias, or scattered. One even has square-cut holes. Here's a run-down on what's available:

Hole Diameter	Spacing (centers)	Hardboard Thickness
CONVENTIONAL		
$\frac{1}{8}"$	$\frac{1}{2}"$	$\frac{1}{8}"$, $\frac{3}{16}"$
$\frac{3}{16}"$	1"	$\frac{1}{8}"$, $\frac{1}{4}"$
$\frac{1}{2}"$	1"	$\frac{3}{16}"$, $\frac{1}{4}"$
DIAMOND PATTERN		
$\frac{1}{8}"$	1"x $\frac{1}{2}"$	$\frac{1}{8}"$, $\frac{3}{16}"$, $\frac{1}{4}"$
SCATTER PATTERN		
$\frac{3}{16}"$	1"	$\frac{1}{8}"$, $\frac{3}{16}"$, $\frac{1}{4}"$
SQUARE HOLE		
$\frac{1}{4}" \times \frac{1}{4}"$	1"	$\frac{3}{16}"$, $\frac{1}{4}"$

Now perforated hardboard is moving into the sound-damping field. Backed with a 2" blanket of fiber-glass, $\frac{1}{8}"$ -thick perforated hardboard with scatter-pattern holes is said to do as good a muffling job as standard $\frac{3}{4}"$ acoustical tile. For sound-

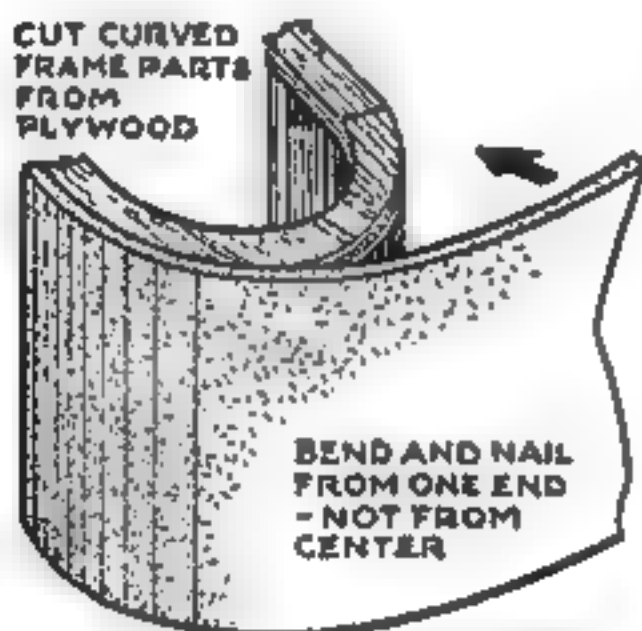
conditioning a workshop or rumpus room, you can nail perforated hardboard over a 1" blanket of fiber-glass insulation tacked to studding. Walls of this type also double as hanger supports for tools and shelves.

Hardboard do's and don'ts. You can saw, plane, file, drill, or sand hardboard easily, either with hand or power tools. Remember, though, that its edges are vulnerable to chipping. When sawing, use a blade with from 8 to 12 teeth per inch and a Number 6 set for straight cuts. For curved and irregular cuts, use a medium or fine-toothed jig- or saber-saw blade. Saw with the blade on the side that will be exposed, as the back may show some chipping where the blade breaks through. (The one exception is with a saber saw. Because the cutting stroke is toward the tool, place the saw on the back of the panel.)

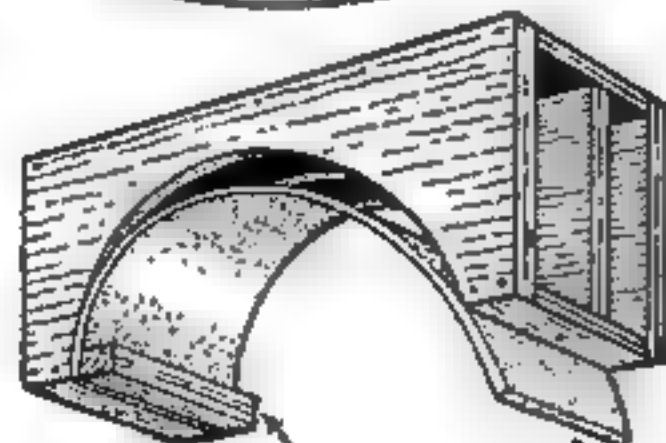
The same work-away-from-the-exposed-face rule applies when filing edges or drilling holes. For drilling, the far side of the panel should bear firmly against a backing block. Use twist drills wherever possible, rather than auger types. Always predrill shank-size holes for wood screws.

Even heavy nails can be driven through hardboard without fear of splitting it—if they're set far enough away from the

CUT CURVED
FRAME PARTS
FROM
PLYWOOD



BEND AND NAIL
FROM ONE END
— NOT FROM
CENTER



RETAINING STRIP
ALONG EDGE

How Hardboard Can Be Bent

TYPE AND THICKNESS	DRY BENDS		MOIST BENDS	
	Minimum Radius		Minimum Radius	
	Side In	Smooth Side Out	Smooth Side In	Smooth Side Out
Standard				
$\frac{1}{8}"$	10"	12"	5"	7"
$\frac{3}{16}"$	16"	18"	8"	10"
$\frac{1}{4}"$	24"	27"	12"	15"
Tempered				
$\frac{1}{8}"$	7"	9"	4"	6"
$\frac{3}{16}"$	14"	16"	6"	9"
$\frac{1}{4}"$	22"	25"	10"	14"
Tempered, both sides smooth				
$\frac{1}{8}"$		10"		7"
$\frac{3}{16}"$		16"		12"
$\frac{1}{4}"$		30"		25"

Radii given apply safely to most makes of hardboard, but it's best to check individual manufacturers' specifications. Some products will take sharper bends than those shown. Manufacturers will furnish information on request.

edge. This distance should be from $\frac{3}{8}$ " to $\frac{1}{2}$ ", depending on the nail size and panel thickness. Never nail directly into the narrow edges.

Recommendations for spacing nails in house construction have been worked out by the American Hardboard Association. Going hammer-happy won't improve any job. Always nail from the centers of panels outward. This insures that the panels will lie flat without buckling. Drive nails perpendicular to the surface to avoid tearing a panel or shifting it sideways. When butting panels, leave a small space between them for expansion.

In wall and cabinet construction, you have many assembly methods to choose from. With the exception of small sliding doors, hardboard should be backed up by, or locked into, framing. Where its edges are exposed, beveling or chamfering will prevent chipping and provide a pleasing appearance.

In covering walls with hardboard, you

can also consider the possibility of "stretching" panels by using division molding or other types of spacer joints that add an extra inch or two of coverage by spreading the sheets a bit farther apart. In this way, you can often make a uniform number of standard panels fit a wall area without ending up with a small, leftover gap that must be filled with a separate piece. This avoids both waste and a messy appearance.

Bending hardboard. Hardboard can be bent around curved framing either dry, or moistened for somewhat smaller-radius curves. For moist bends, submerge the area to be curved in water not more than 100 degrees F. for at least 40 minutes. Or you can scrub the back of the panel with hot water, and keep that surface saturated with wet rags or newspaper for 24 hours before applying the sheet to the framing. This has the advantage of preventing damage to the factory finish on the outer surface. ■ ■

My Most Embarrassing Shop Moment

WHILE employed as an engineer in New England, I received a gift that I'll long remember. It was an unlabeled, but full, gallon can sent to me by a friend who had been selling motor oil to our company.

I took the can home and stored it in the garage. A few weeks later my car needed oil so I opened the can and poured in a few quarts. The car ran fine—for a while. Suddenly, it started sounding like the inside of a boiler factory and I barely made it to the service station. The mechanic just shook his head and said that, whatever it was, he'd have to tear the engine down to get at it.

The next day, the mechanic phoned me to come take a look. The insides of the engine were practically glued together solid with a thick, sticky gunk.

The mechanic asked what kind of oil I had been using and I replied: "Oh, it seemed like about No. 20. I put it in my—" Then a light bulb lit up and I made a dash for home. Sure enough, the can I had thought was motor oil didn't smell like it. It was something very sticky and sweet.

I called my oil-salesman friend to ask him what it was and he bellowed back: "Why

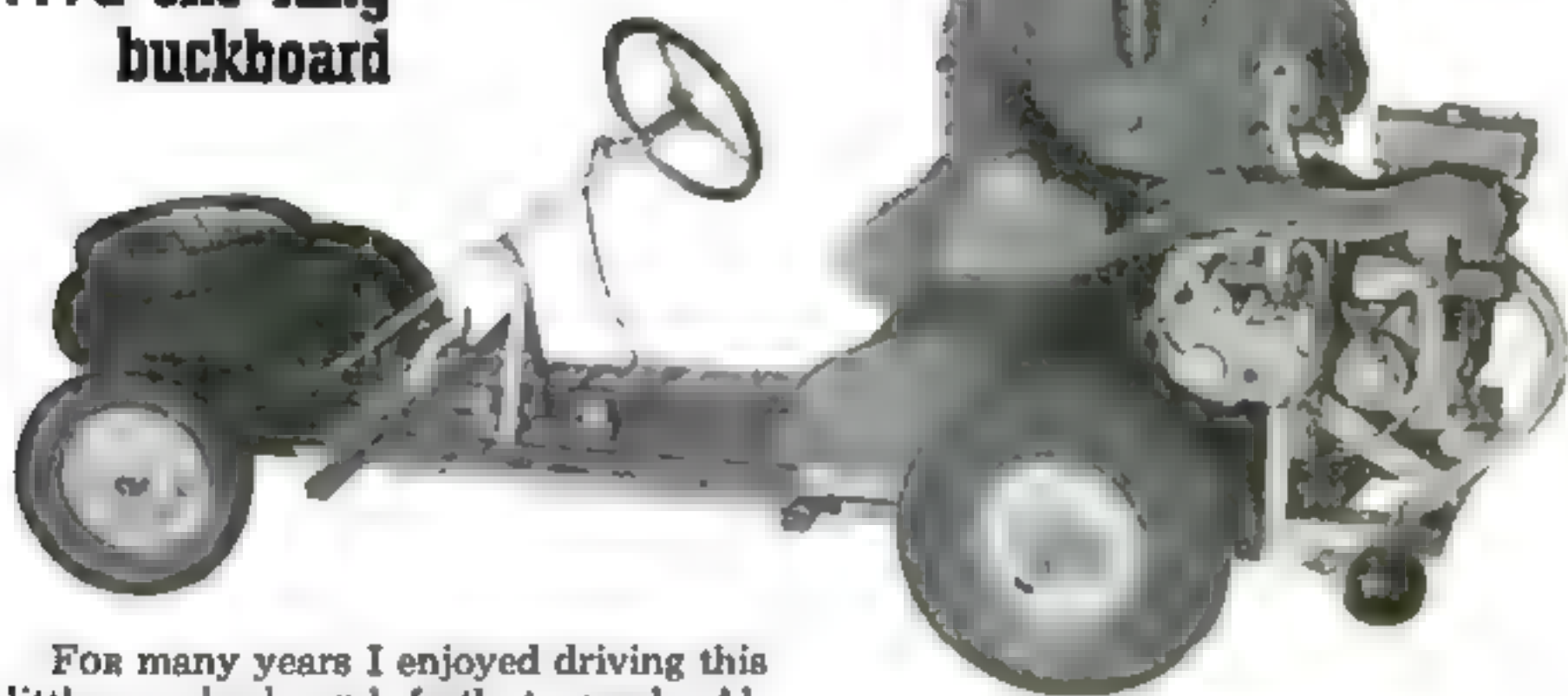
you ungrateful boob. That was a gallon of New England's best homemade maple syrup right from my own farm."

My lack of curiosity about the unmarked can cost me \$60 for the engine tear-down, a gallon of mouth-watering maple syrup, and almost a fine friendship. I still get the horse-laugh whenever my wife serves griddle cakes. —Leon W. Richardson, Zephyrhills, Fla.



My PRIZE project is...

... a one-lung buckboard



For many years I enjoyed driving this little car back and forth to work. Although it has four wheels, I was able to have it licensed as a scooter.

Power from a little half-horsepower Briggs & Stratton engine is delivered to the wheelbarrow wheels through a

three-speed Harley transmission. I added a fan from a refrigerator unit to cool the engine. Two spares, for front and rear wheels, are stacked up ahead.

LOUIS M. GOODMAN, Lake Worth, Fla.

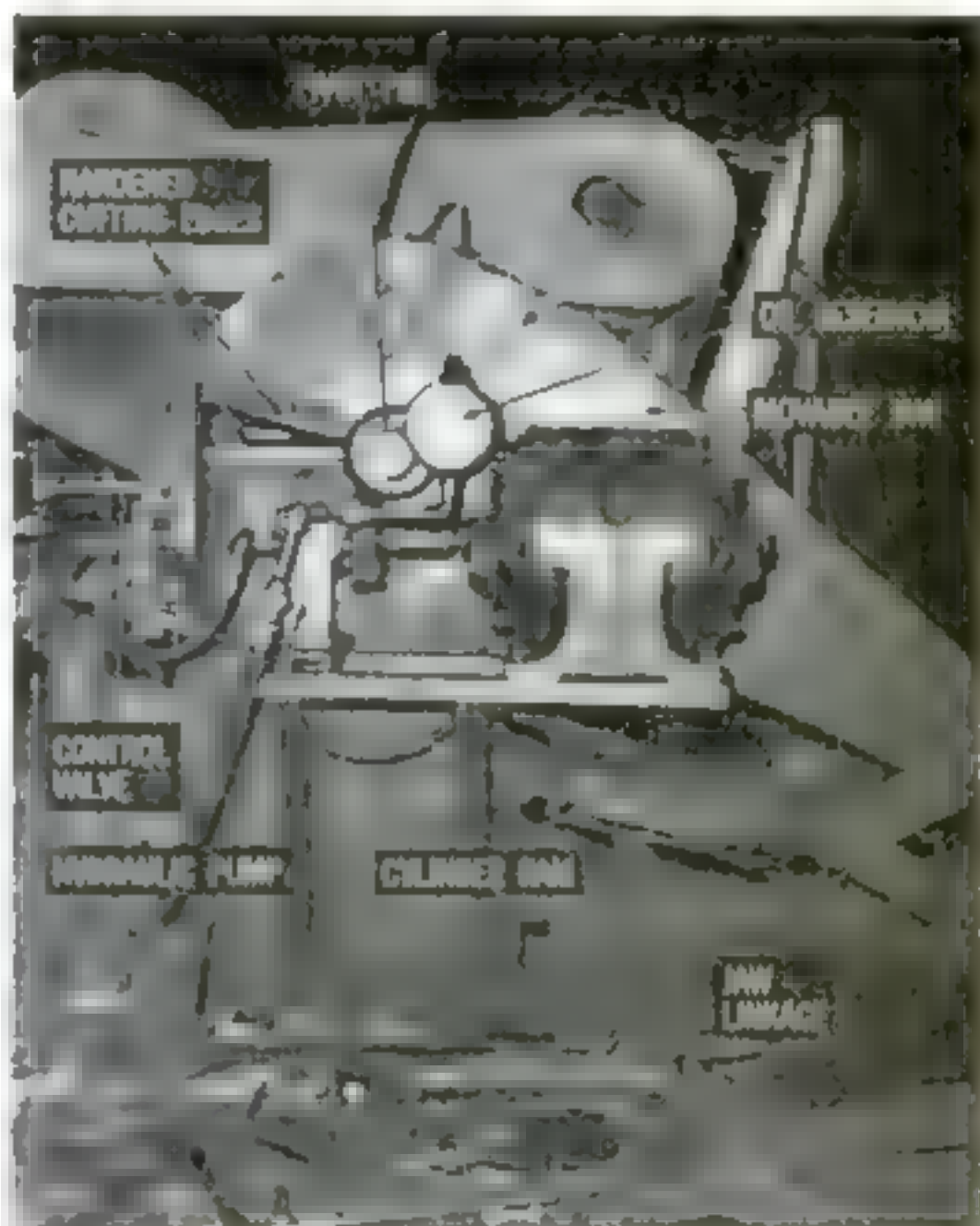
... a hydraulic metal shear

IN THE machine shop where I work, I've received many compliments on this machine. At the touch of a lever the shear will bite through steel $\frac{3}{8}$ " thick and 6" wide.

Most of the parts are salvaged junk. The one-hp. motor drives a hydraulic pump taken from a Ford tractor. I repaired an inoperative control valve and hooked it to the pump.

The cylinder ram was made from a piece of 3" pipe. I bored and honed it, and fitted it with a piston. O rings seal it against leaking. The 1"-thick steel base and movable jaw were once the counterweights on a power shovel. The jaw pivots on a 2"-diameter pin. Cutting edges were ground from a bulldozer spring.

ROY WALKER, Okanogan, Wash.



Short Cuts and Tips

FROM PS READERS

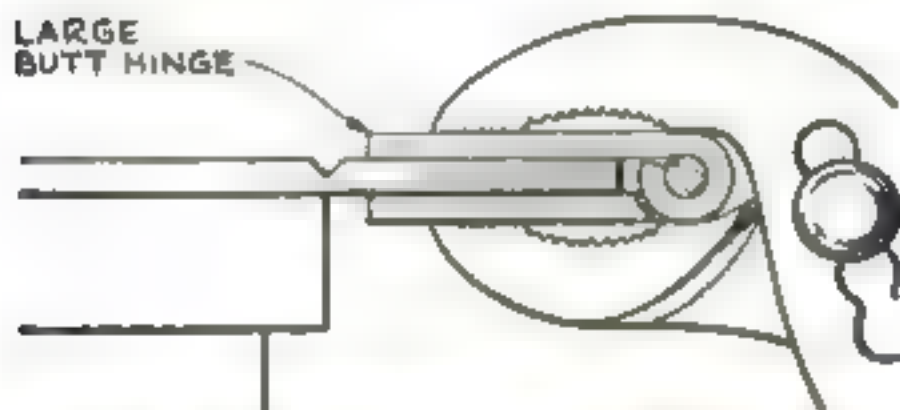
More Light from a Post Lamp

You can get more light from a post lamp if you line the inside of the cover with aluminum foil, shiny side down. This can increase the lamp's brightness by as much as 15 percent.—*M. Steele, Winter Park, Fla.*

▶▶▶ **LIKE** to patch insect screens quickly? Cover the holes with small pieces of mosquito netting and spray on two coats of shellac from a spray can.

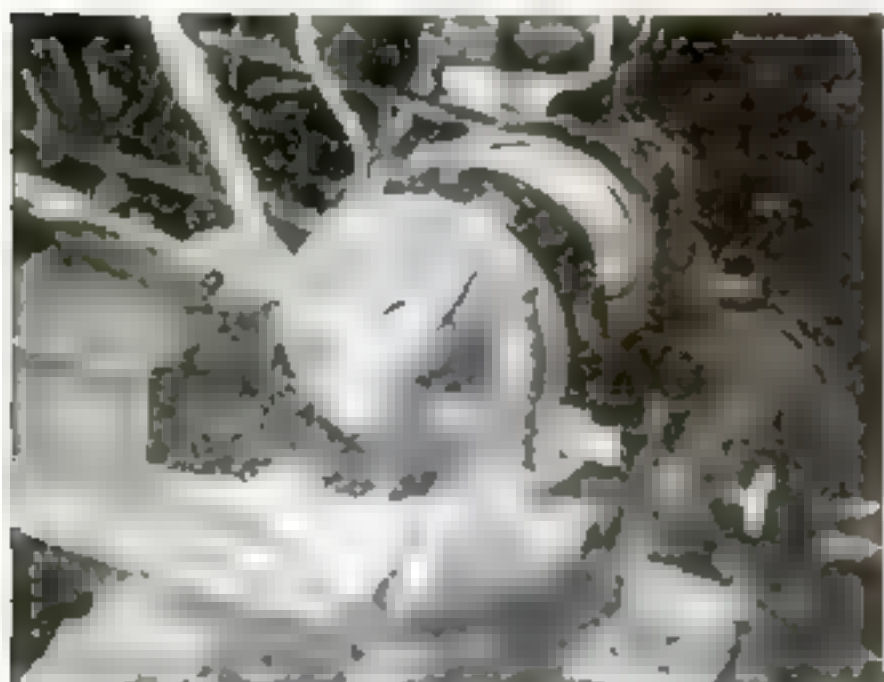


LARGE
BUTT HINGE



Hinge Aids Glass Cutting

WHEN you're cutting glass, you can break off the scored strip more easily by folding a large hinge over the edge and gripping it with pliers, as at left. The hinge distributes pressure evenly and keeps the glass from cracking in the wrong place.—*W. C. Wilhite, Carlinville, Ill.*



Blocks Make Cut-Off Tool Rigid

A CUT-OFF tool will be less likely to chatter or grab if mounted between two slotted steel blocks, about $\frac{3}{8}$ " square and 2" long, locked securely in the lathe tool-post. Overhang is reduced to a minimum, and the blocks provide a longer area of support than the ordinary holder.—*Floyd McGuckin, Ridgewood, N. J.*



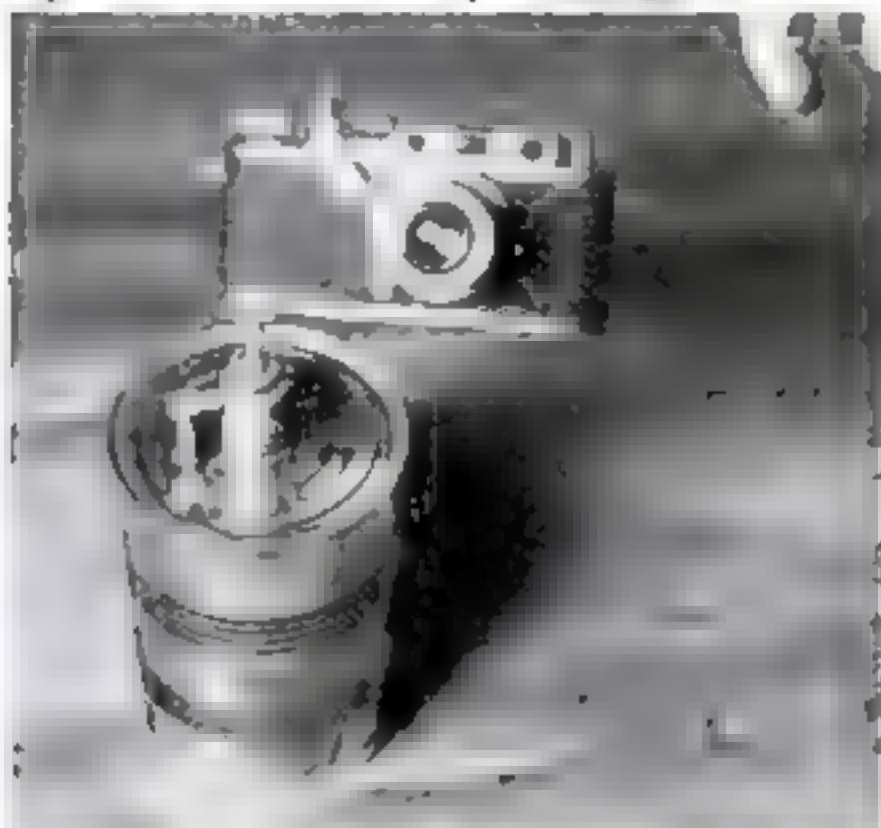
Keeping Brace and Bit Level

WHEN you're trying to hold a brace and bit level, this trick will give you a straight hole every time. Slip a large washer over the bit and watch how it moves. If it slides toward you, the brace is too low; away from you, too high. When you're level, the washer won't move at all.—*William B. Eagan, Maceo, Ky.*

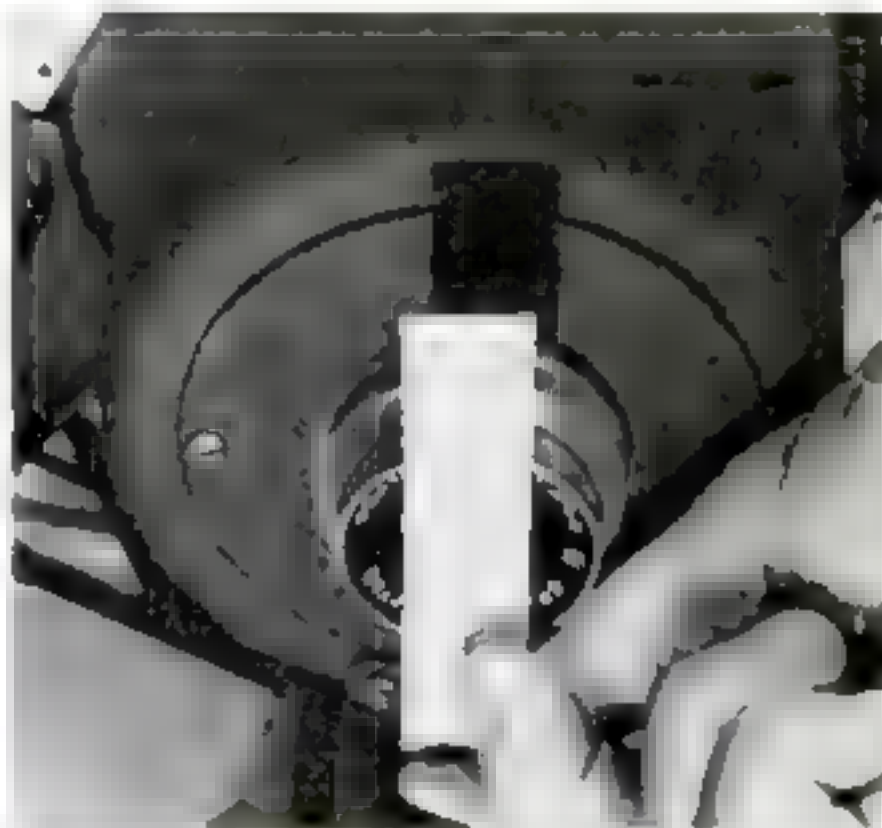
Photo Tips



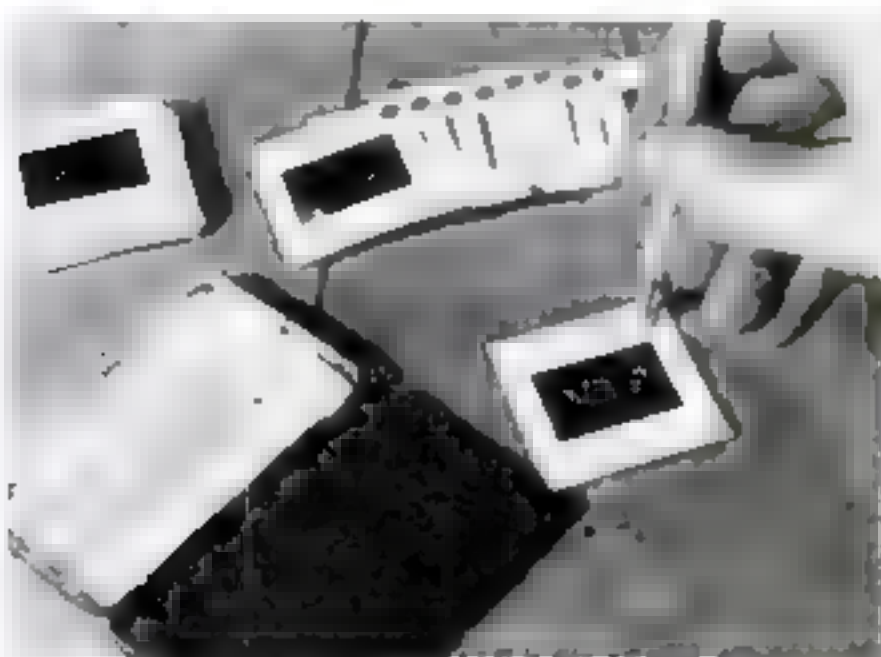
GOOD PARADE PHOTOS are hard to get with a reflex camera, but you can do the job by shooting over the heads of the crowd this way. Fasten the camera—upside down—to the end of a stick about 3' long with an angle bracket. Add a 40" cable release and you'll find it's easy to look up into the view-finder and snap the shot you want.



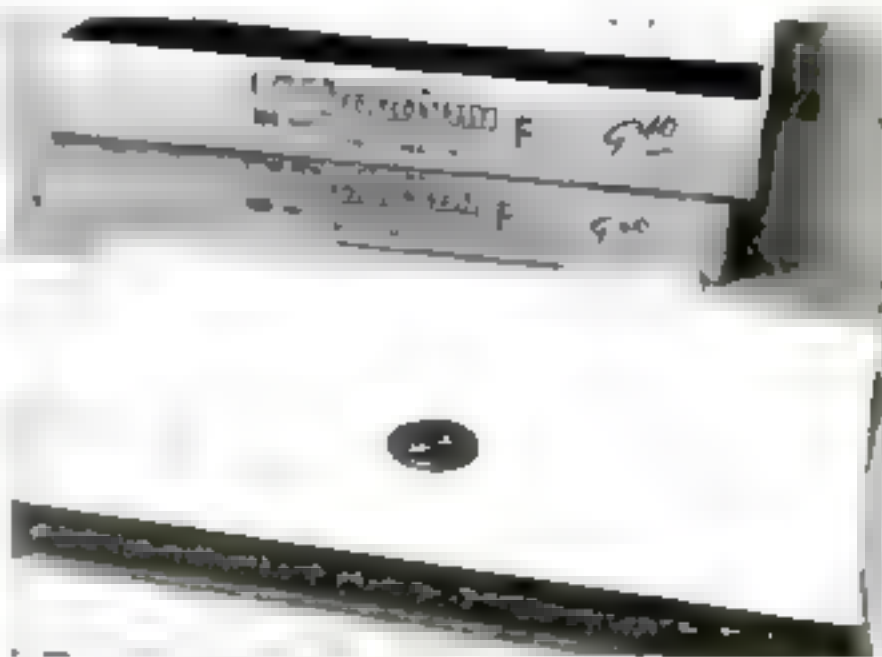
TRY THIS "CAN POD" for those difficult low-angle or table-top shots that can't be made with a tripod. Bolt a small swivel head to a large fruit-juice can, and you'll be able to set the camera at any angle. Cover the lower rim of the can with tape to provide a nonslip edge.



YOU CAN FOCUS AN ENLARGER accurately with this split-beam trick. Hold a strip of cardboard across the center of the lens. When the enlarger is out of focus, you will see a double image on the easel. As the focus becomes sharp, the images will blend into one.



YOU CAN MARK SLIDES QUICKLY for correct projection with an ordinary pencil eraser and an ink pad. Arrange the slides in the proper upside-down and left-right order, then stamp a dot in each upper right-hand corner. You'll be able to spot the dots even in dim light.



IS YOUR SAFELIGHT SAFE? Here's how to tell. Place a coin on a sheet of photographic paper for two or three minutes, then develop the paper. If the coin's outline shows up, it means the light is too bright. Dim it with a lower-wattage bulb or move it farther away.



Tip on Carrying Road Flares

THE sharp spikes on emergency flares carried in a car trunk can scratch your hands and mar valuable luggage. Muzzle their bite by pressing the points into corks.—*H. Leeper, Canton, Ohio.*

▶▶▶ If you need a gluing jig for small picture frames and don't have special corner clamps, try a tennis-racket press. The corners can be squeezed together as you slowly draw the screws up tight.—*Will S. Underhill, Schenectady, N. Y.*



Guide for Portable Saws

THE miter gauge from a table saw can be used as a guide for making angle cuts with a portable circular saw or saber saw. Turn it upside down and, for easier handling, mount it on a strip of wood.—*Robert Micals, Freehold, N. J.*

4 Projects for the Outdoors

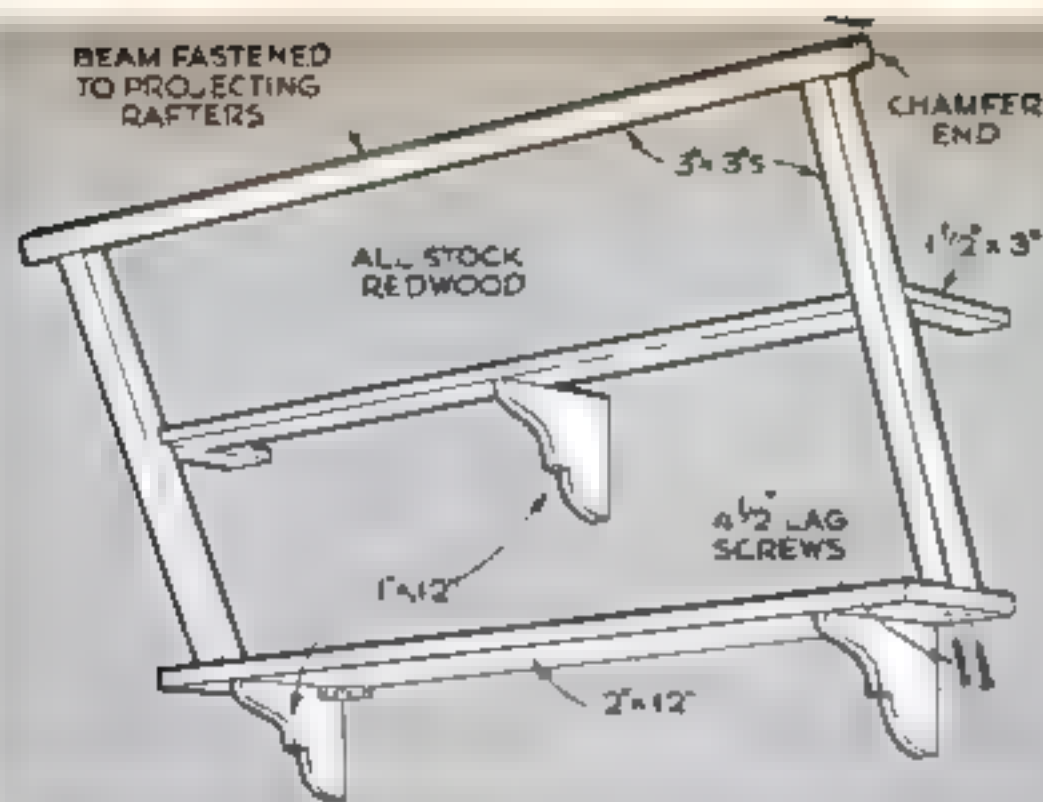
Flower Shelf for Back-Yard Building

HERE'S an idea you might adapt to the side of a garage or other building—a flower shelf attached to its side. The orig-



A Carrying Base for a Patio Flowerpot

HERE'S a solution to the problem of moving a heavy outdoor flowerpot, one on a patio, for example. The plant rests on a two-piece base jigsawed from waterproof plywood. With the pot on the circular centerpiece, you (and a helper if one is available) lift up the outer piece until it catches on the flange of the pot. The circular base can be slipped into place after the plant has been shifted.—*W. C. Wilhite, Carlinville, Ill.*



inal was tied into the construction of a garden house at the rear of the home of Mr. and Mrs. A. M. Brook of Los Angeles. It's provided with a skylight of corrugated plastic, notched into the pro-

jecting roof, so that the flowers get sun.

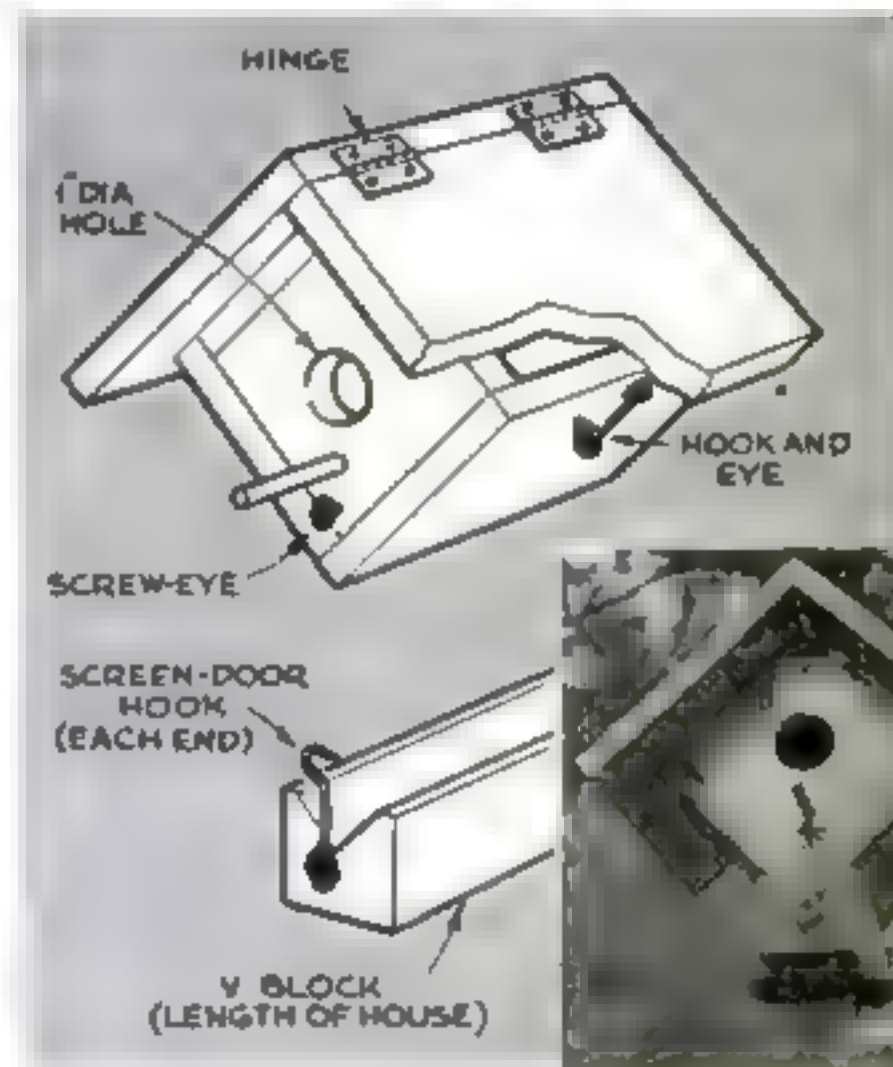
A variation could be worked out for any pair of under-eave windows, though it may be necessary to extend existing rafters.—*Hi Sibley, Nuevo, Calif.*



Wagon-Wheel Chair for the Lawn

You can duplicate this lawn chair with a little lumber, a few pieces of pipe, and one or two old wagon wheels. Two wheels were used in this case, and the hub of each one retained. But you could simply cut one wheel in half.

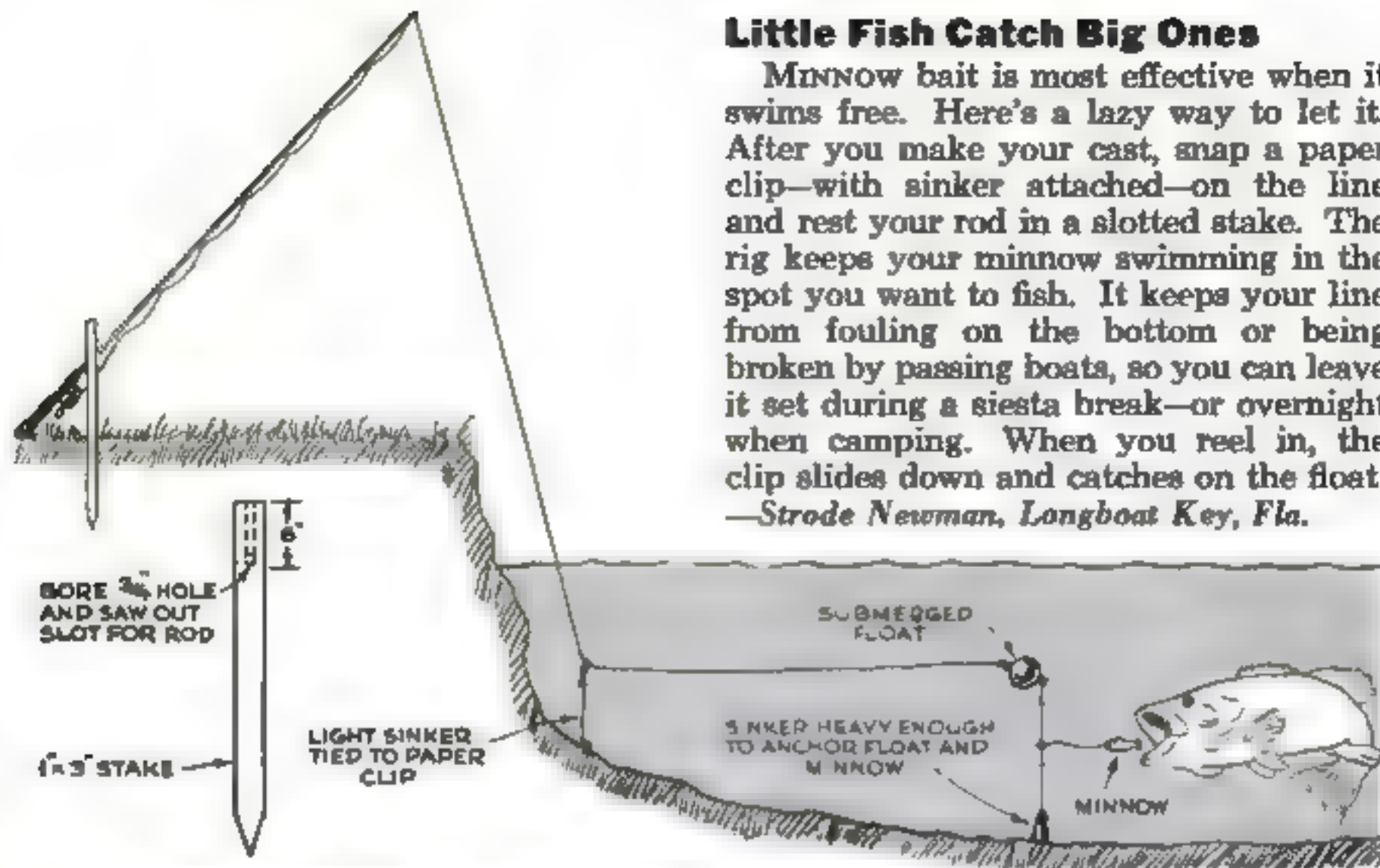
Two lengths of pipe bolted to the spokes support the seat. The base consists of pipe bolted together into a rectangle with a fifth piece between the hubs.—*Grover Brinkman, Okawville, Ill.*



Wren House Built for Easy Cleaning

It's no trouble at all to give this wren house its annual cleaning, a job that must not be neglected if you want tenants. It was specially designed to make the job easy.

Screen-door hooks secure it in the 90-degree notch of the base, mounted permanently atop a post. This makes it possible to take it down and remove the old nest through the hinged roof.—*H. A. Fluchere, Irvington-on-Hudson, N. Y.*



Little Fish Catch Big Ones

MINNOW bait is most effective when it swims free. Here's a lazy way to let it. After you make your cast, snap a paper clip—with sinker attached—on the line and rest your rod in a slotted stake. The rig keeps your minnow swimming in the spot you want to fish. It keeps your line from fouling on the bottom or being broken by passing boats, so you can leave it set during a siesta break—or overnight when camping. When you reel in, the clip slides down and catches on the float. —*Strode Newman, Longboat Key, Fla.*



Homemade Punch for Leather

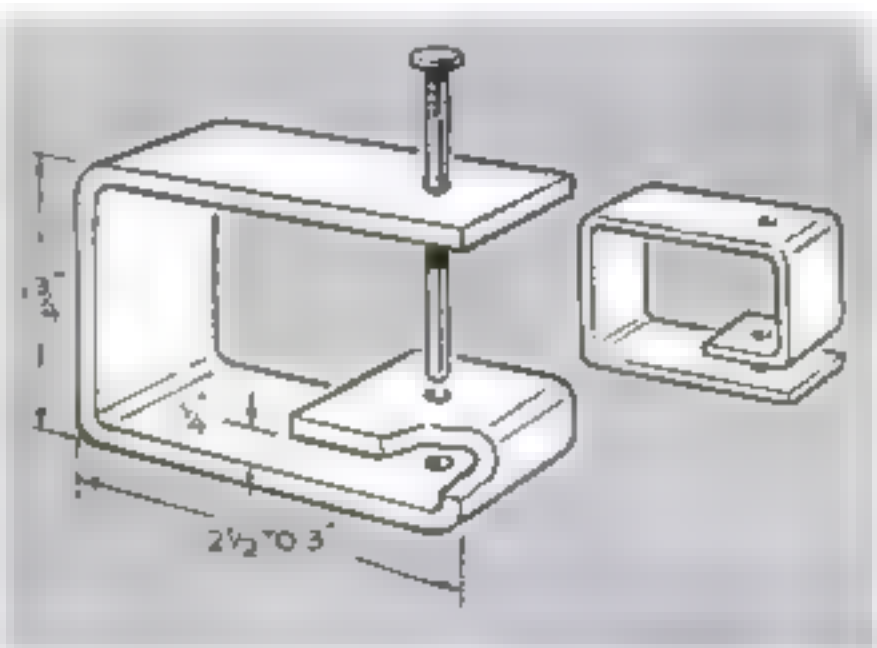
NEAT holes can be punched in leather with this simple tool. Bend $\frac{1}{8}$ "-by-1" strap iron to make the frame. The smaller of the two shown at right illustrates a frame with greater throat depth but less rigidity. Choose a nail that will make the size hole required and grind or file the end flat. Drill holes through the frame to take the nail.

To punch through leather, place it in the frame and hit the nail with a hammer. —*Harry Scholl, Fayetteville, Ark.*

Renewable Treads for Mower

WHEN the treads wore off the tires of my self-propelled mower, I installed renewable treads with little trouble and expense. I used No. 10 insulated electric wire to do the job.

I first spotted 12 points at equal distances midway around the side of each tire. I then drilled holes through the tire at an angle of about 20 degrees upward and toward the front. Finally, I laced the wire over and over the tire through the holes, stripping off about 4" of the insulation from the ends to twist them snug with pliers. —*Elmer L. Green, Atlanta, Ga.*





Short Cuts and Tips FROM PE READERS



For a Contented Dog, Try Vacuuming Him Clean

FOR several months, I have been dry-cleaning my basset, using the household vacuum cleaner. The method is much easier and just as efficient as the previous soggy episodes in the laundry tub.

I use the upholstery attachment. The suction reaches through the dog's coat to the skin and removes all dirt and loose

hair—even burs and fleas. You should move the nozzle in the direction of the dog's coat, as in brushing, and go slowly until the dog becomes accustomed to the noise.

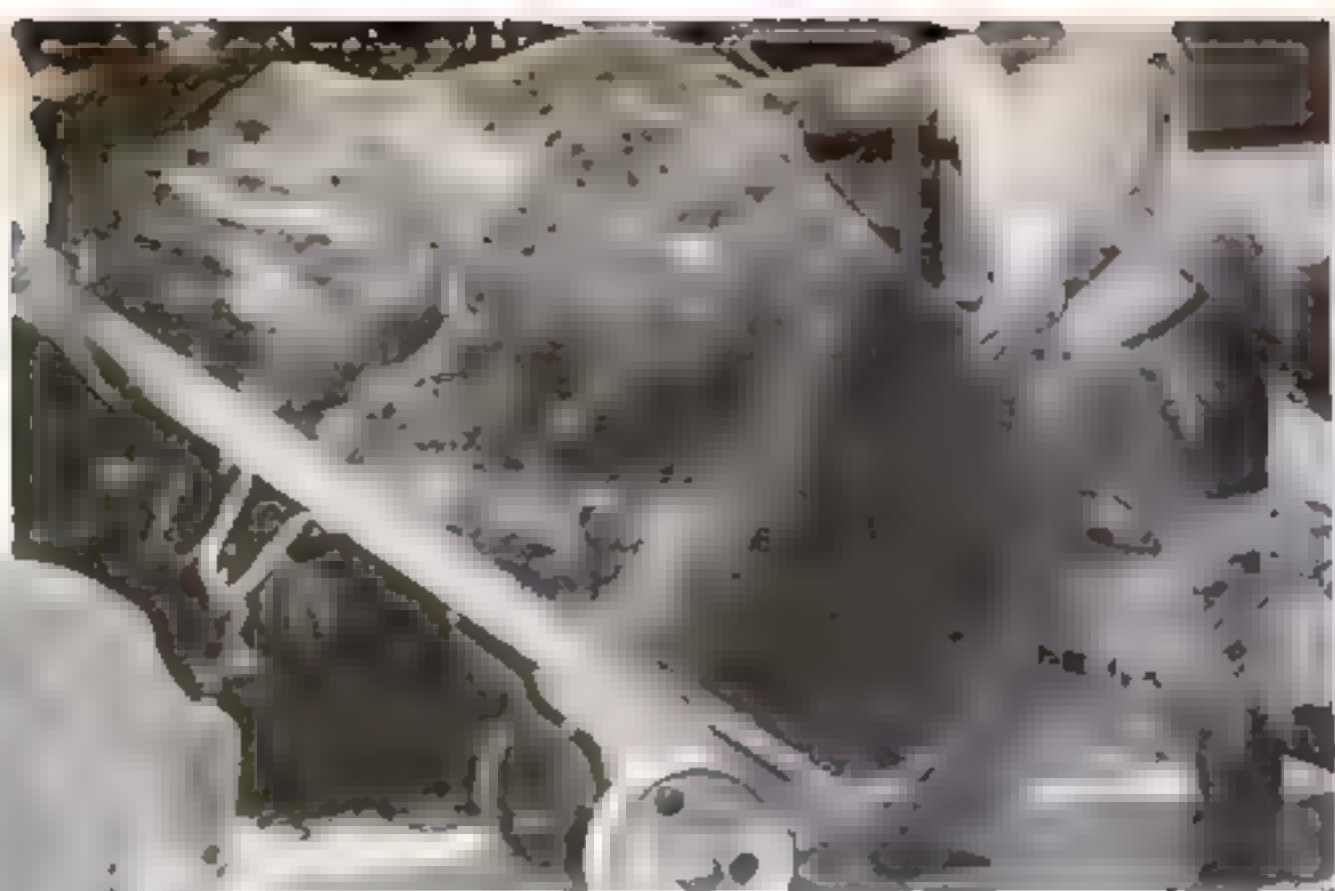
As you can see in the photos, the dog enjoys the massaging action of the cleaner.—*Alan Linn, Cincinnati, Ohio.*

String Silences Faucet Drip

A PIECE of string can silence the maddening drip-drip-drip of a leaky faucet until you get around to replacing the washer. Tie the string around the end of the faucet as shown in the photo at right. It will carry the drops into the sink silently, permitting you to sleep with peace of mind—even though you put off until next morning the repair that should have been made last night.—*Grover Brinkman, Okawville, Ill.*

▶▶▶IF BAD weather injures a favorite tree, remove the split limb or broken stub by sawing close to the main trunk. Protect the exposed wood from decay and infection by spraying on several coats of shellac or tree-wound paint.





WHERE DO YOU WANT IT, MA'AM? Boulders up to 6' around are delivered right to your door. Called Featherrock, the light volcanic lava weighs only a fifth as much as ordinary rock.

NOW YOU CAN BUY

Lightweight Building Stone from a Volcano

Even a child can heft huge chunks of cellular lava foam, or expanded obsidian. It's cut from the slopes of extinct volcanoes in California

FOR FACING WALLS, you can get Featherrock in thin veneers with a rough surface like field stone (below, left) or with formal square-cut slabs (directly below). A ton of rock costs about \$100, depending on type, and covers 100 square feet.





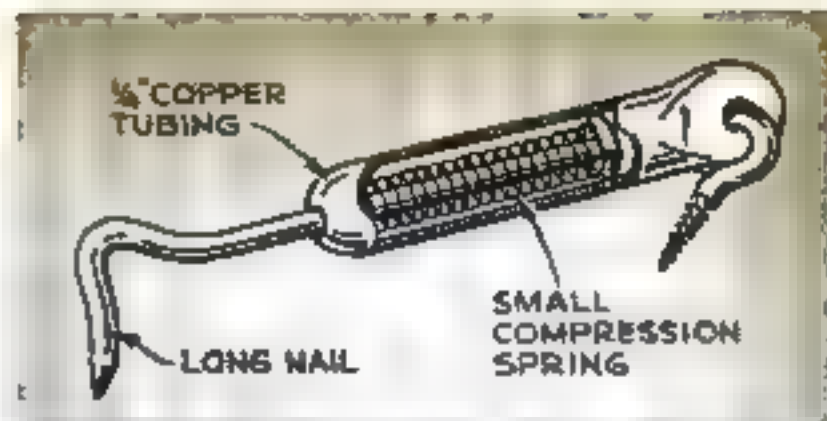
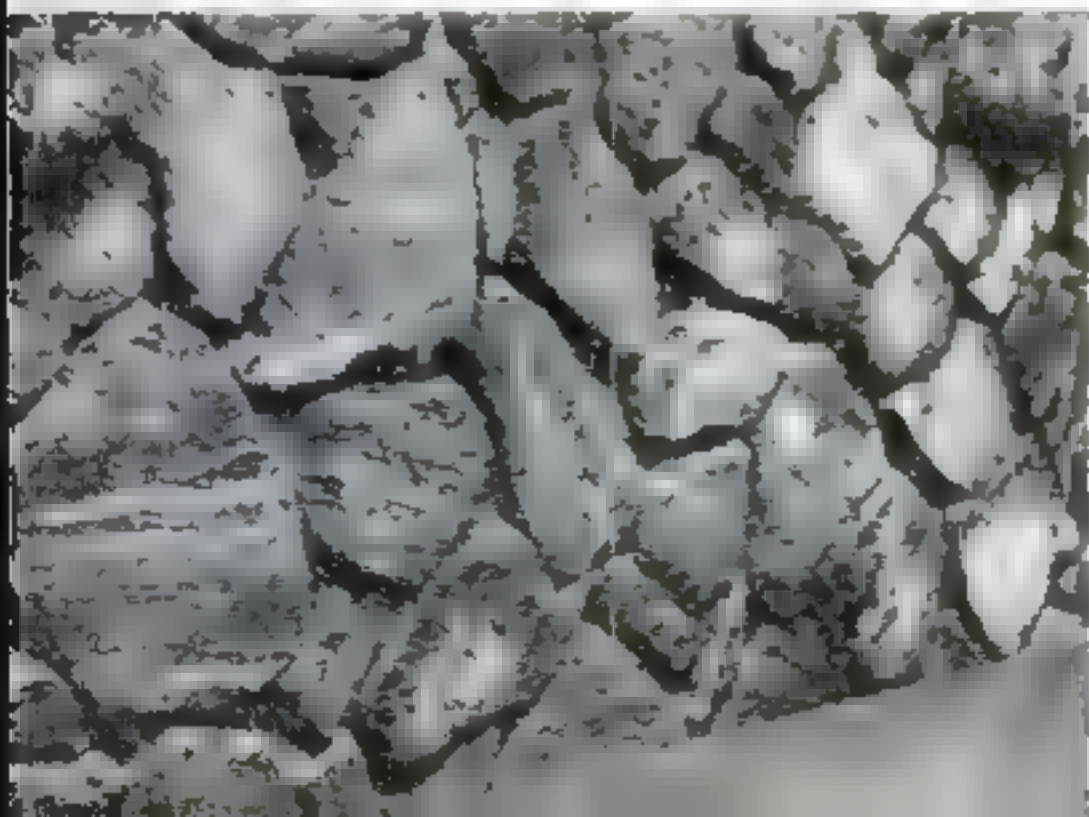
MASSIVE ROCK GARDENS are easy to create with huge stones like these, available in almost any size and shape you want. Note the rock at right above carved to represent a figurehead.



PLANTS GROW right out of the rocks without soil because the porous structure holds moisture, air, and root food. This makes the stones especially good for rock-garden arrangements.

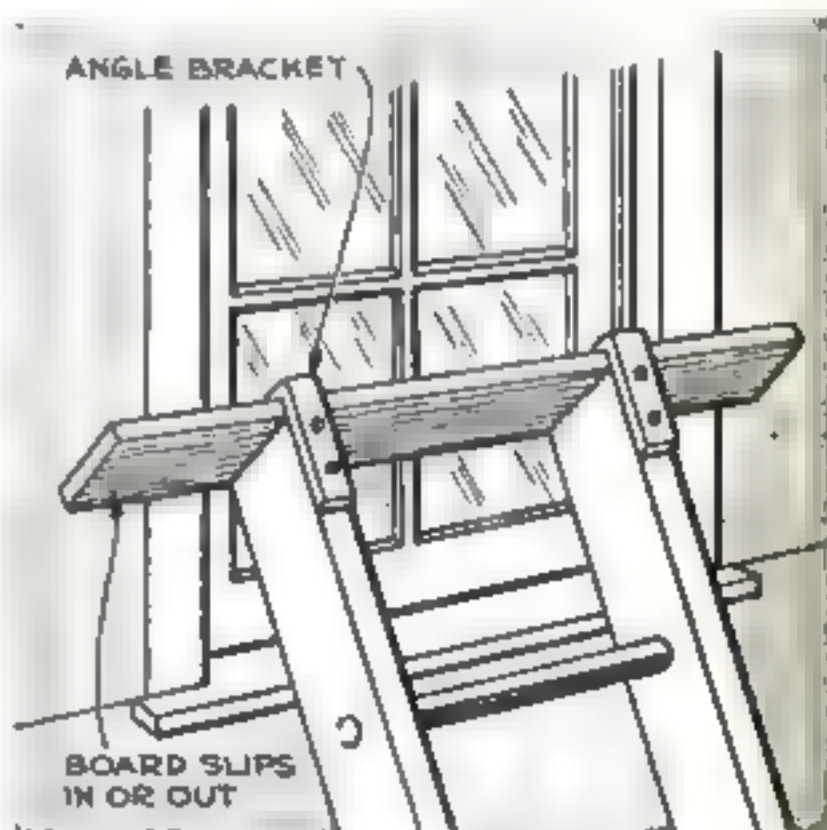
STRONG YET SOFT, the handsome volcanic rock can be shaped with saws, chisels, and abrasive bits to make figures, planters, bird baths, and other decorative yard objects.

RANDOM-SHAPED VENEER SLABS are flat sawed on both front and back for easy installation. Featherrock is sold throughout U. S. by Featherrock, Inc., 6331 Hollywood Blvd., Los Angeles.



Hooking Loose Doors Tight

SCREEN door won't close tight? The gate is loose? A spring-loaded hook will solve the problem. Take a 2" length of $\frac{1}{4}$ " copper tubing and round over one end with a hammer until there's a small hole. Slip a small coil spring over a long nail so that the spring seats against the nail's head. Insert the nail into the tube with the point projecting through the hole. Flatten the other end of the tube to hold the nail in and drill it to attach a screw-eye. Bend a hook on the nail point. Mount the screw-eye so the spring is about half compressed when the hook is in place.—D. Millard Lake, Osburn, Idaho.



Window-Proofing a Ladder

WASHING windows from a ladder resting against the sill or on the siding alongside makes it hard to reach all parts of the glass. Use angle brackets to hold a board across the end and you can place the ladder directly over the window. The board is also helpful when you're painting above and below the windows. It can be slipped out of the brackets when not needed.—Daniel Bousha, Jackson, Mich.

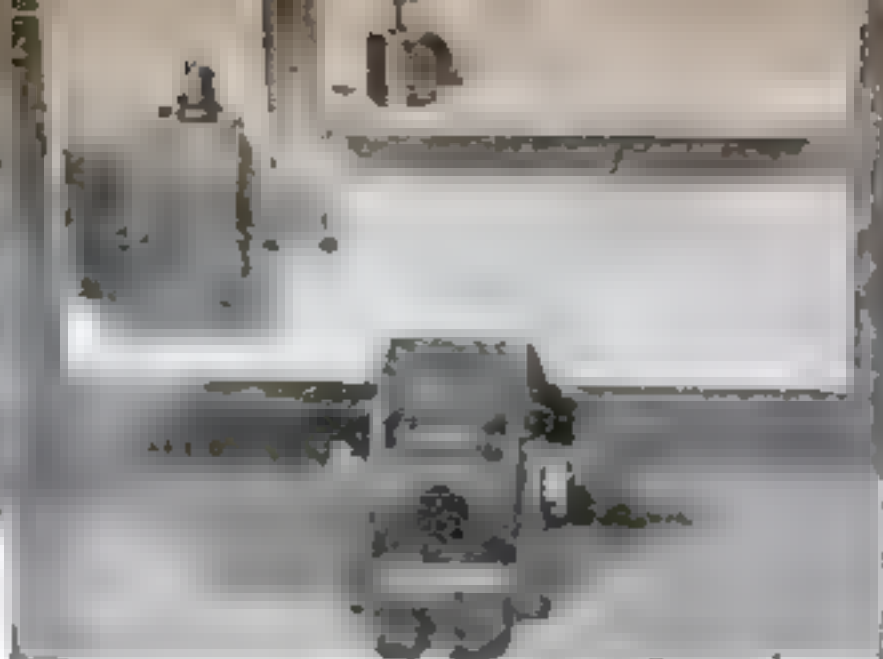


A CLOCK SPRING that has broken off at its anchor point can be reset if you know how to make new holes for the screws. A steel block, slotted and drilled through for a pin punch, will help you make neat holes in a flat spring.

5 PROBLEM-SOLVING TIPS FOR:

Working with Springs

By Walter E. Burton



MATCH THE STIFFNESS of a new spring to the old one with this easily made setup. The wire is clamped to a block so that its outer end supports a weighted arm on a pivot. The comparative amount of bend for each wire is read on a scale fastened to the backboard.

CUTTING SPRING WIRE is tough on regular wire cutters. An easy way is to bend the wire back and forth between two pairs of pliers until it breaks. Heavier wire can be nicked with an abrasive stone before breaking it.



NEAT, ROUND LOOPS can be made by bending the wire a full turn, then a half turn, and snipping off the overlapping end. Special cutters with hardened steel jaws should be used.

TO LIGHTEN THE ACTION of a spring, reduce its diameter by rubbing it as above with a fine-grit abrasive stone moistened in oil. Check its stiffness frequently as you slim it down.



The best car news
of 1981
is happening under your hood!

What's the news?

MONEY! Saved for you through the prevention of clogged radiators and plugged pressure caps. This added protection will prevent rusted water pumps, burned valves,

scuffed cylinder walls, overheating of transmission and engine oil, fuel squandering, and loss of air conditioning caused by cooling system failures.

And what's new?

DOWGARD® FULL-FILL® COOLANT!—

A new concept in automobile cooling system fluids that can save you many repair bills by

keeping the many parts of your cooling system in "like new" condition from the day your car rolls off the assembly line!

What is DOWGARD Full-Fill Coolant?

Chemistry looks under your radiator cap. Dow chemists took a close look at the most overlooked part of your car . . . the cooling system. They chopped engines like yours apart, dismantled radiators. Part by part, they found grim evidence of clogged radiators, corroded water pumps, thickly scaled engine blocks! Even with "normal" care, cooling systems were found to have aged long before their time.

A close look proved, for complete protection, everything under the cap should come from the lab! When the final inspection had been completed and the evidence weighed, one fact was clear: your car's worst enemy is water. Even when mixed with antifreezes or rust inhibitors, ordinary water turned cooling systems into "boiler systems." The answer? Permit no ordinary water in the system! Instead, produce a completely laboratory-controlled fluid for your car's engine.

A NEW CONCEPT IN COOLANTS

DOWGARD Full-Fill Coolant is the first coolant of its kind. It represents an entirely

new concept in automotive coolants. Nothing is ever added to DOWGARD Full-Fill Coolant . . . no water, no rust inhibitors, nothing. DOWGARD Full-Fill Coolant is used to fill your car's cooling system from bottom to top.

WHY THEY GOT RID OF ORDINARY WATER!

(and why you should, too)

The good is none too good and the bad is murder on metals! On a hot day when thirst is every third word you think of, a bubbling spring, a water hose or a sink faucet is about the best thing you can find. Great for you, perhaps, but not for your car.

Water, in its most pure state (rain) absorbs carbon dioxide from the atmosphere as it falls to earth. Water with carbon dioxide, after it enters the earth, dissolves many minerals and carries them along either suspended or in solution. Sediment, microorganisms, fluorides, calcium and magnesium salts join the parade by the time rain water has become "well water."



In a six week test, discs of these cooling system metals were inserted in DOWGARD Coolant and also in a solution of a good antifreeze and water. The difference between the two sets of discs was remarkable. Those taken out of the antifreeze water solution showed definite signs of rust and corrosion. On the discs which had been in DOWGARD—not a speck!

Even soft water is hard on your car!
Water in your area may be soft as a downy pillow yet be hard on your car's cooling system.

Why?

Because water impurities are divided into two groups. Those that cause water to be "hard" are calcium and magnesium. Remove them and the water can still be corrosive. That's because of other corrosive elements which may be present in even soft water. These elements are chlorides, sulphates and bicarbonates. They're extremely corrosive in a cooling system, not only attacking metal surfaces, but building up formations of corrosion products on engine walls.

Ordinary inhibitors were a compromise that didn't satisfy Dow chemists!
The trickiest thing of all about natural water, however, is its variable composition. Impurities in water where you live may not be the same in the next state—or even in the next county. This has made it impossible for chemists to develop an inhibitor capable of protecting all the metals, including aluminum, in your cooling system equally well in all waters.

Rust inhibitors (even those put in antifreezes) have had to be compromises, designed to do fairly well under most conditions but not necessarily the best under any given water condition. The only way to build the perfect inhibitor system was to formulate the complete coolant.



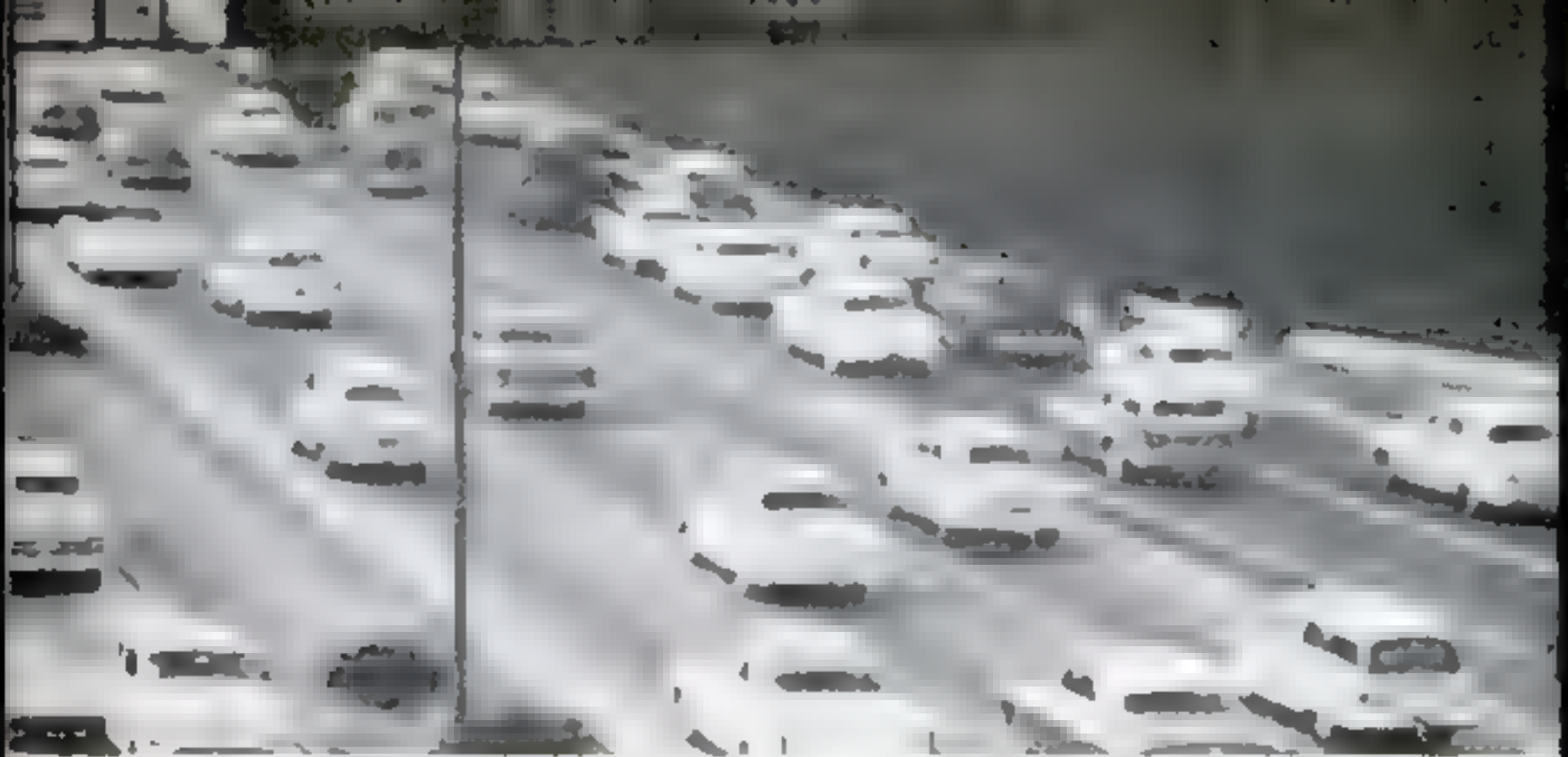
What DOWGARD Coolant does for you and why

Improves Performance and Economy! The better you vaporize your fuel, the more you economize. DOWGARD Coolant can help your car's intake manifold vaporize the fuel-air mixture better when it's sent to the combustion chambers. That's possible because DOWGARD Coolant permits your engine to run closer to optimum temperature. You get better manifold ring, better fuel distribution.

This can mean better performance, increased gas mileage. In addition, DOWGARD keeps this temperature even under stress by keeping the cooling system clean. Water, by causing rust, corrosion and clogging, can heat metal temperatures too high in time, producing actual engine damage such as burned valves, cylinder wall scuffing.

DOWGARD Coolant keeps flowing, you keep going in cold weather or hot. DOWGARD Coolant is especially important when you're in snow, bumper-to-bumper traffic during the summer and your car's engine has to pump and a burning piston to take a breath. Water will often "batter-head" your car, shut your engine off suddenly after a hot trip, causing coolant to escape and make things even worse when it comes time for you to take off again. DOWGARD Coolant resists boiling, performing the proper function of heat transfer long after water would have become a vapor.

At the other end of the thermometer, DOWGARD Coolant is guaranteed to protect against freezing damage anywhere in the continental U.S. Details on back cover.



Takes the heat off air-conditioned cars!

Air conditioning puts an extra load on your car's engine after having to overheat just while you're trying to heat the heat. The safety margin in DOWGARD Coolant means that it will stay put, keep going, longer than water. And in water-cooled air conditioning units, where the evaporator coils and heater cores are sometimes made of brass, DOWGARD Coolant will prevent freezing in the heater core.

Keeps octane requirements constant!

Water causes corrosion of car's oil pan, oil, oil gas hot pump. It's as simple as that. When your engine starts running too hot because of poor heat transfer through the cooling system, your engine's octane appetite pumps. A little scale can materially increase the temperature of cylinder metal surfaces. If true, your engine could start requiring gasoline with a higher anti-knock octane rating. You can keep your engine from developing such expensive tastes by keeping DOWGARD Coolant in the system from the day you buy your car.

Helps control fluid temperatures in automatic transmissions!

The same liquid that cools your engine also cools the fluid in your automatic transmission. And the corrosion in this interface is enough to ruin the transmission and thus can increase oil temperatures, reduce viscosity and increase the heat that ruins oil seals. DOWGARD Coolant assures you of clean-controlled cooling in the transmission.

Maintains cooling systems at full capacity by preventing rust and corrosion!

Water can reduce your car's cooling system capacity. It can pump inadequate cooling system water to the amount of coolant that can be circulated. It also restricts its flow. This is critical in modern high compression engines, loaded with power equipment that was never intended to be under the skin of the rig, exposed radiators. Your engine needs every watt of cooling capacity it was designed for. DOWGARD Coolant keeps the cooling system in the new condition, cooling metal surfaces instead of insulating them with scale and corrosion.



DOWGARD Coolant gets the checkered

EVENT	RESULTS
CAMORAL 1500 Winston Champion No bug King Derby	1st and 2nd place 1st place
LeMans 24 Hour Endurance Race Paris	1st place
Road America Winston Salem	1st place
INDIANAPOLIS MOTOR SPEEDWAY 500	1st place
NATIONAL TRAIL CHAMPIONSHIP DETROIT	1st place
NASCAR WARD 500 Charlotte	1st place
Durham 500 Charlotte	1st place

EVENT	RESULTS
Hartford 500	1st and 2nd place
Nashville Tennessee	1st and 2nd place
Weaver 500	1st place
Lynchburg 500	1st and 2nd place
AC 500 Double Header	1st and 2nd place 1st and 2nd place
PEAK AIR 500	1st and 2nd place
Champion 500	1st and 2nd place
St. Louis 500	1st and 2nd place
Spokane 500	1st and 2nd place

AND DOWGARD COOLANT IS NOW ON ITS WAY TO MORE VICTORIES IN 1961!



DOWGARD Coolant finishes in first 10 again and again during '61 NASCAR Daytona Speed Weeks

An impressive total of 746 of all participating cars used DOWGARD Formula Coolant during the February NASCAR Speed Weeks. And driver confidence in this new coolant was well placed. DOWGARD was used in from 4 to 6 cars placing in the first 10 in every major event on the 1.6 mile track.

You can't lose—it's guaranteed against loss and freezing. In 1958 cars, or newer, DOWGARD Full-Fill Coolant is guaranteed by Dow for a period of 24 months or 24,000 miles, whichever occurs first, against loss of the coolant from the cooling system—irrespective of the cause.

This guarantee covers, for example, loss resulting from such things as a collision, a faulty water pump, or other matters over which Dow has no control. If a loss occurs within the first 6 months (6,000 miles) replacement is free; if from 6 to 18 months (6,000-18,000), you save 50% of the then retail price; from 18 to 24 months (18,000-24,000), you save 25% of the retail price.

The conditions of the guarantee require only that DOWGARD be installed in a 1958 or newer car by a service dealer, that the cooling system be in good condition at installation, and that the cooling system be inspected, and repaired if necessary, every 6 months.

In addition, Dow guarantees for two full years to repair any damage to the engine or cooling system, caused by freezing of the cool-

ant, in any car, anywhere in the continental United States, in which DOWGARD has been properly installed. This is not subject to the limitations concerning model year, etc., which apply only to the guarantee against loss.

When you figure the cost—you'll see you save! DOWGARD Coolant is sold for a suggested retail price of \$2.25 per gallon, about what you'd expect to pay for a premium coolant. For most American cars, this means a complete fill of DOWGARD Coolant costs \$8 to \$12. Figured over a two-year period, you pay only \$4 to \$6 a year for all the benefits of this laboratory-controlled fluid. Nothing else does so much for your car for so little!

Proper installation protects your investment. DOWGARD Coolant is available through your recognized service dealers. This assures you of professional installation by trained service personnel. You'll get all the good out of DOWGARD Coolant that the laboratory put into it.



Get the best out of your car—put DOWGARD Full-Fill Coolant in it today

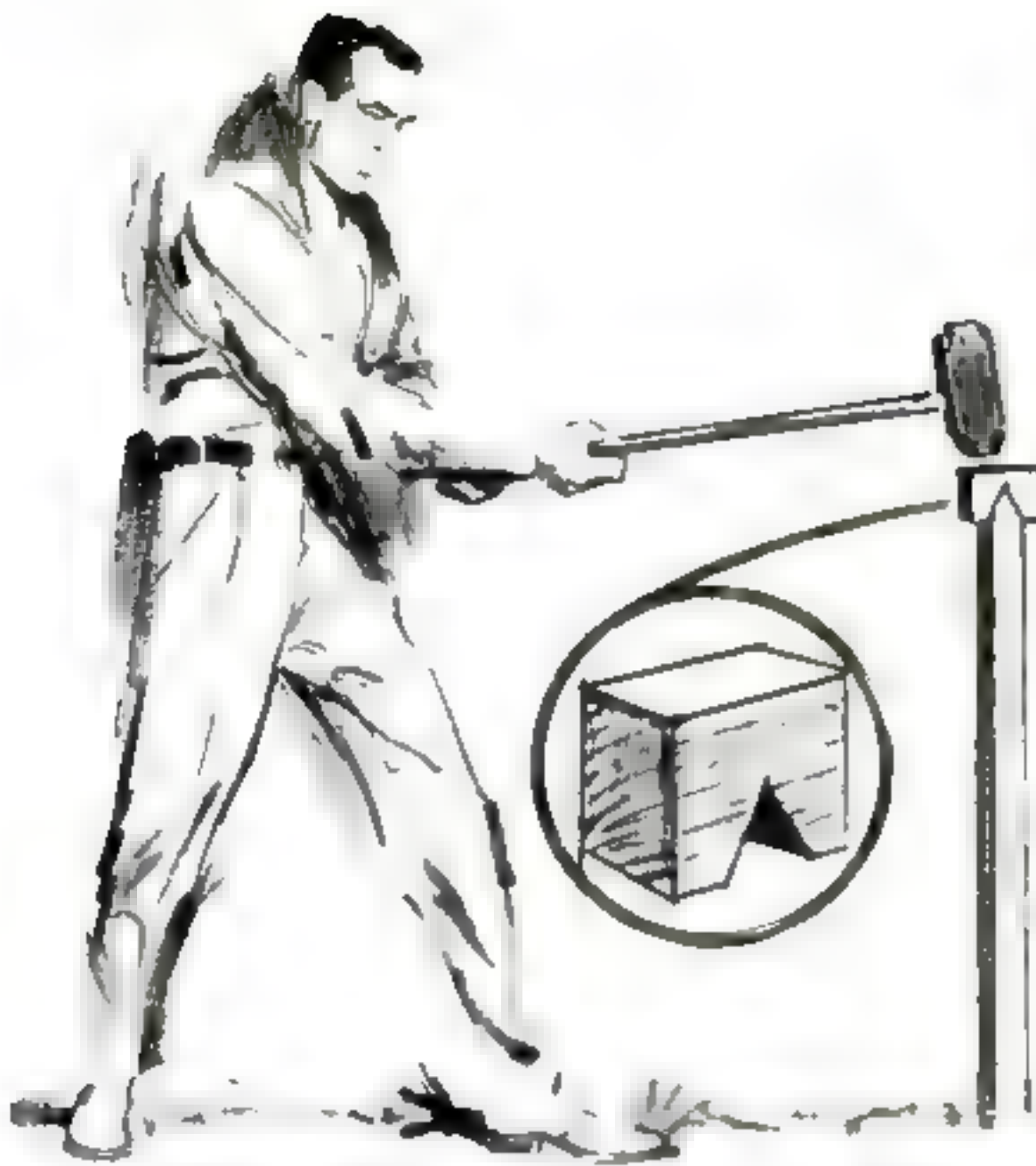
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The Dow Chemical Company • Midland, Michigan



Short Cuts and Tips

FROM PS READERS



Block Drives Fence Pickets

You can drive fence pickets into soft ground without damaging the points on the upper ends. Do it this way. Make a V-shaped block from hardwood to match the point, and hammer against it as shown.—*Daniel Bousha, Jackson, Mich.*

▶▶▶ To KEEP a picture from slipping and hanging askew, support it on two hooks placed on the wall an inch or so apart. This will keep the wire from slipping and the picture from dropping down at one corner.

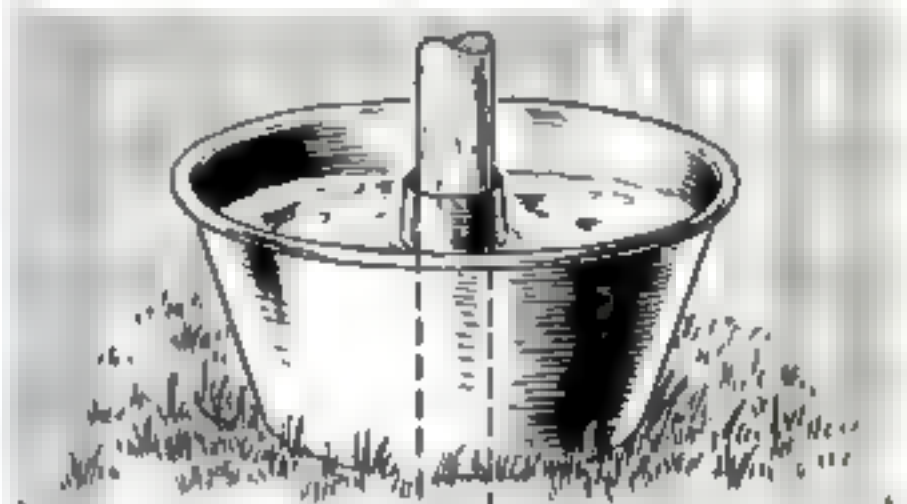
Sandpaper Erases Ink on Paper

FINE-GRIT abrasive paper or cloth can speed the removal of stubborn inked lines, particularly long ones, from mechanical drawings. It can do all of the removing, or be used after preliminary scraping with an etching knife. If the abrasive is of sufficiently fine grit, it will also restore much of the paper's smoothness. Suitable grit sizes include 3/0 and finer.—*Walter E. Burton, Akron, Ohio.*



Staples Lock Down Screws

To KEEP a screw from loosening, drive a staple into the wood so it seats in the slot. You can place the staples with a gun or tap them home with a tack hammer. Pointed staples are best.—*R. J. De Cristoforo, Los Altos Hills, Calif.*

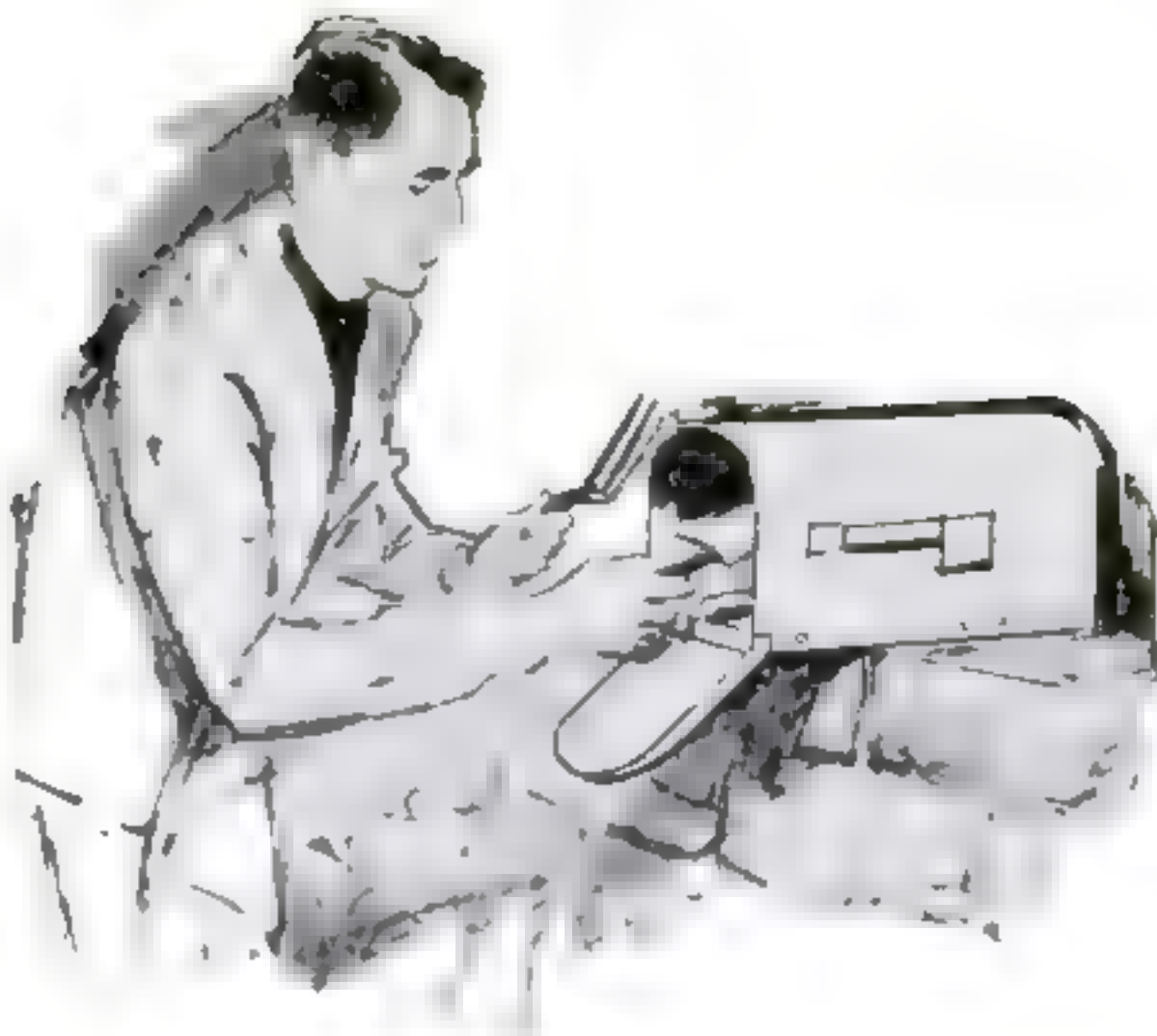


Stake Anchors Pet's Pan

THE dog or other pet that drags his empty water or food pan over the yard can be foiled. Drive a stake in the ground at his feeding and watering spot and drop an angel-food cake pan over it.—*Charles Carroll, Marion, Ohio.*

Mailbox Stores Garden Tools

A BIG rural mailbox makes a perfect place for storing small garden tools right where they're needed. You can fasten it to the side of the house or mount it on a post or wall near the garden. Colorfully painted, it will look attractive and keep tools from weathering.—*Mrs. Roland Feldmann, Plymouth, Wis.*

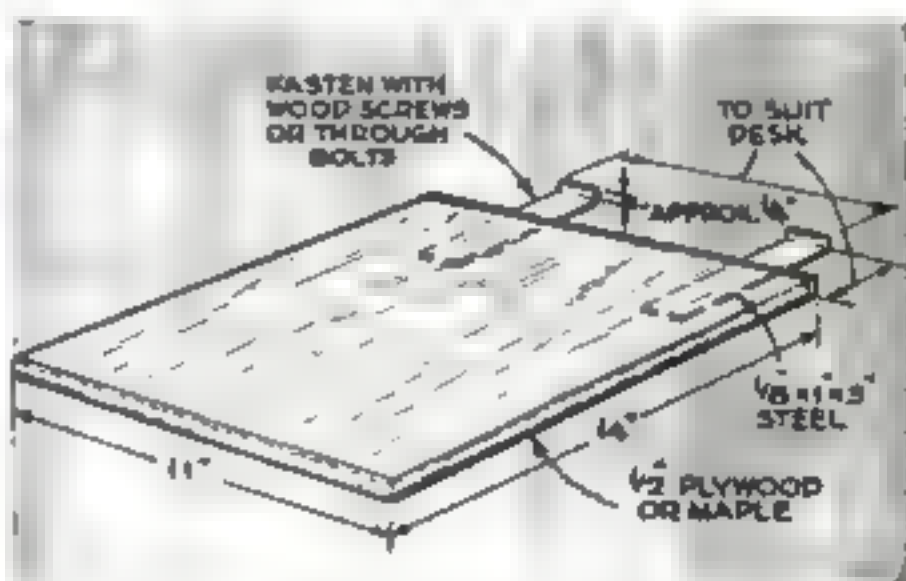


Magnet Pulls Out Chips



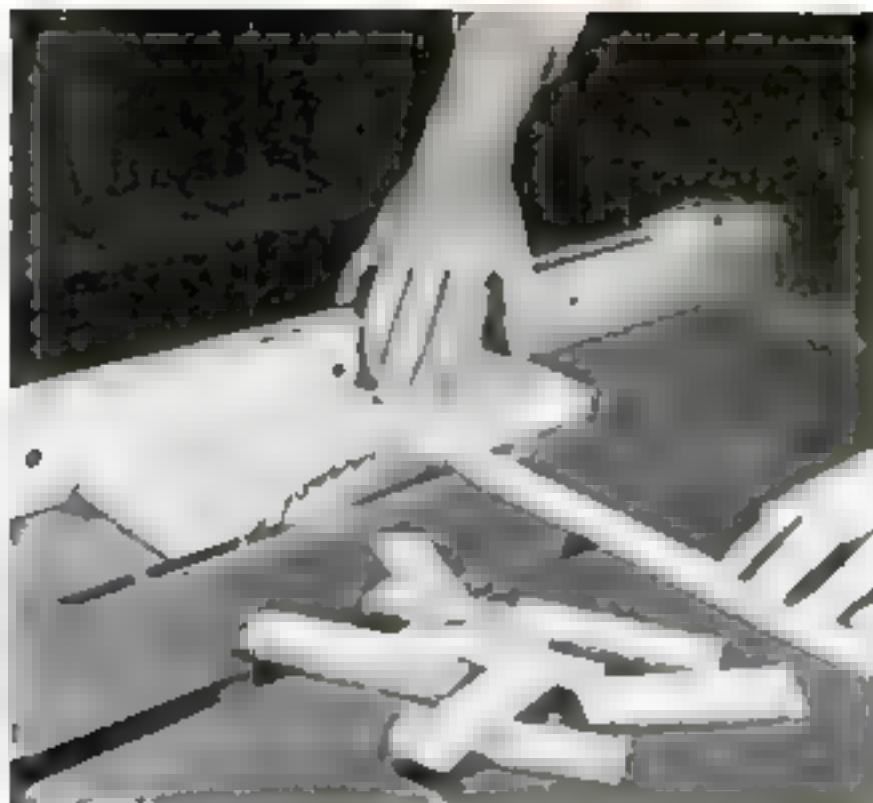
SMALL chips of metal that refuse to be dislodged from drill holes can often be withdrawn by attaching a horseshoe magnet to a nail or other narrow piece of metal to extend the magnetic pull into the hole.—*Charles Carroll, Marion, Ohio.*

▶▶▶ ACCIDENTALLY, I applied an overdose of lighter fluid to ignite the charcoal in our barbecue grill. The flare-up blistered the finish on the hood. After refinishing with spray-can enamel, I took steps to prevent a recurrence. I bought a large hot-pad—*asbestos sheet, faced with metal—to fit inside the hood. With the metal side toward the grill, the pad also increases efficiency by reflecting heat. By chance, mine wedged neatly in place, but it could be secured with small bolts.*—*John G. Voelker, Timonium, Md.*



A Desk Board for Typing

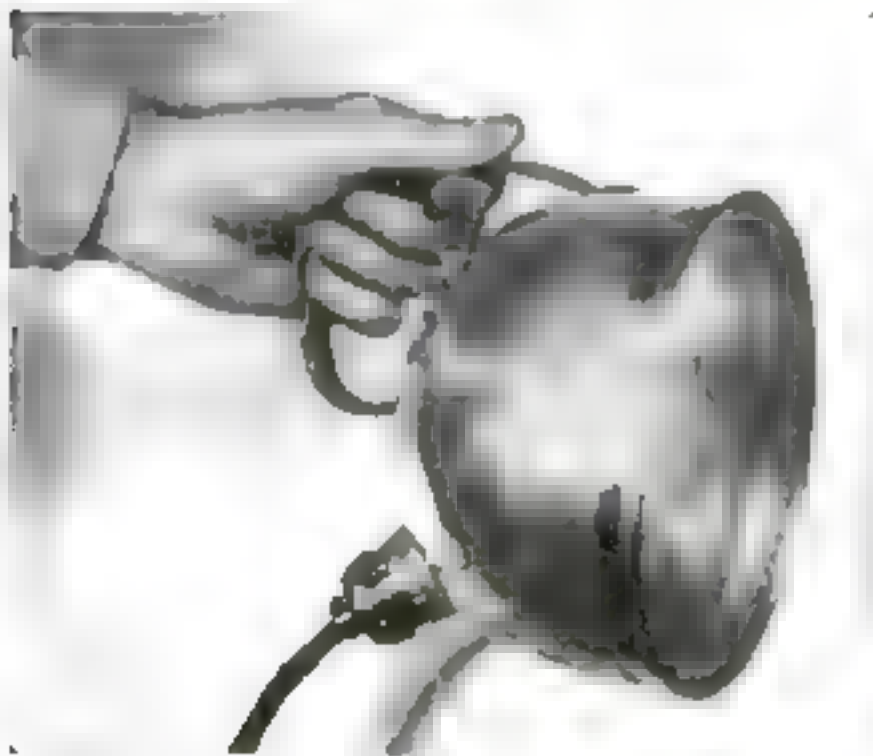
HERE'S a handy place to use a portable if you don't have a regular typing table. The board rests on one of the half-opened drawers of a conventional desk. Clips keep it in place. A strip of felt cemented on the back edge of the board prevents scratches on the edge of the desk.—*Archibald Black, Stafford Springs, Conn.*



Jig for Duplicating Pieces

YOU can make a jig for cutting duplicate lengths by forming a dado across a block of wood. Cut the dado to match the thickness and width of the stock, the width of the jig to equal the length of pieces needed. A finger hole in the top makes it easy to feed.—*R. J. De Cristoforo, Los Altos Hills, Calif.*

▶▶▶I CONVERT my portable circular saw to a sander by removing the set from an old blade and cementing on abrasive disks. It works great on awkward jobs like trimming doors and always leaves a square edge.—*Alston Alsbaugh, Lancaster, Ohio.*

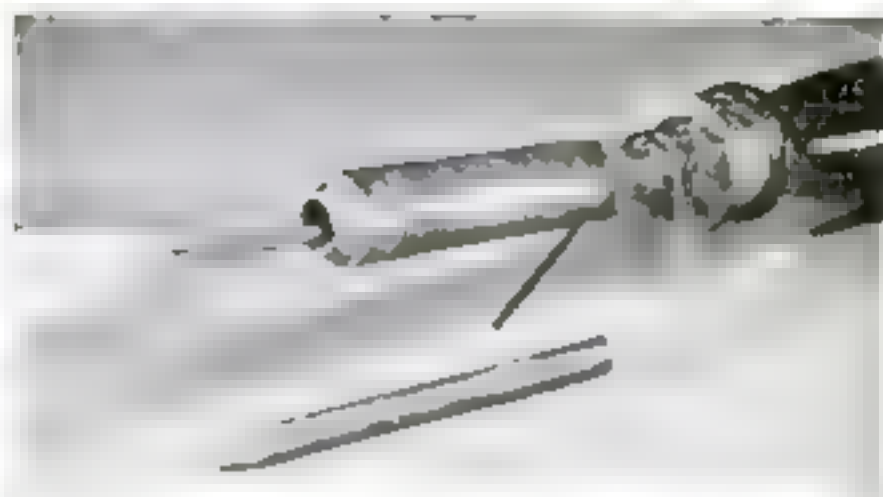


Spotlight from a Teakettle

HERE's the spotlight that I rigged up in a few minutes from an old teakettle that was beyond repair. After knocking out the bottom, I fitted a lamp socket into what was the pouring spout.—*William Swallow, Brooklyn, N. Y.*

Short Cuts and Tips

FROM PS READERS



Iron for Fine Soldering

WHEN you have a delicate soldering job to do but not the iron for it, here's how you might improvise:

File a tip on a copper rod of a size suited for the job, and fit it with a handle. Remove the tip from a large iron and heat the miniature by inserting it in the unit.—*Bill Toman, Palatine, Ill.*

▶▶▶TO PRESERVE the interior of outdoor wooden flower boxes from decay, shake kerosene over the interior (enough to wet it), set it afire, and let the wood char well. You're then set for years.—*L. W. Richardson, Zephyrhills, Fla.*



Cash for the Mailman

WHEN I want to leave the mailman money for stamps, I stick the coins to a strip of cellophane tape and suspend the strip inside the box. He readily sees the money and there's little chance of its getting lost.—*W. B. Egan, Maceo, Ky.*

HOMEMADE Filter for a Small Pool



By C. J. Padfield

THE water in our small above-ground swimming pool stays crystal clear all summer. A dirt and sediment filter that I built from junk parts keeps it sparkling.

The system operates like the filters you see on home aquariums. A motor-driven water pump from a washing machine draws water through a plastic pipe at the bottom of the pool and pumps it into the top of a filter tank. The water flows through sand and crushed rock in the tank, leaving dirt behind as it returns to the pool. Chlorine poured into the pool, every other day or so, prevents the growth of algae.

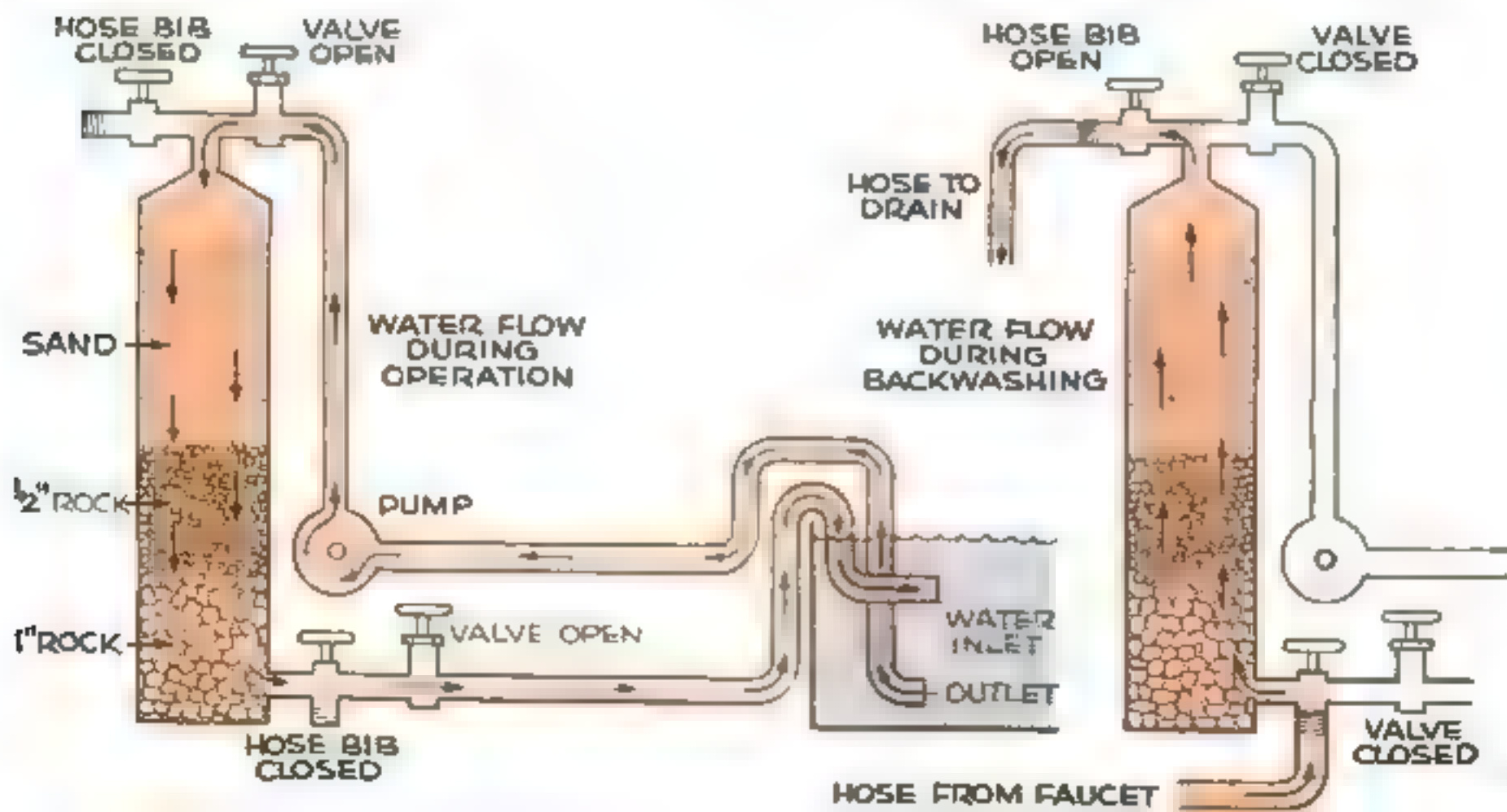
Any tank will do for the filter as long as it has pipe fittings at top and bottom; but an old hot-water tank, or the type of tank used in water-softener systems, is best suited to the job. Remove any baffles or pipe that might be inside. Pinholes in the tank can be soldered, or mended with plastic aluminum or steel to make it watertight.

Load the tank about three-quarters full with clean, crushed rock and white sand, laid in three layers as shown in the drawing below.

Connect the valves, hose bibs, and washing-machine pump to the tank, using adaptors or short pipe nipples, if necessary. If threads are difficult to match, short lengths of rubber hose can be used to assemble the parts. Run rigid plastic pipe from the filter to the edge of the pool, then over the side and into the water. Plastic pipe fittings are joined to the pipe with the special polyethylene cement sold with the pipe. For a neater job, run the pipe underground to the pool.

Fill the pool, and connect a hose to the top hose bib and run water into the filter tank to prime the system. To operate the filter, close both hose bibs, open both valves, and turn on the pump.

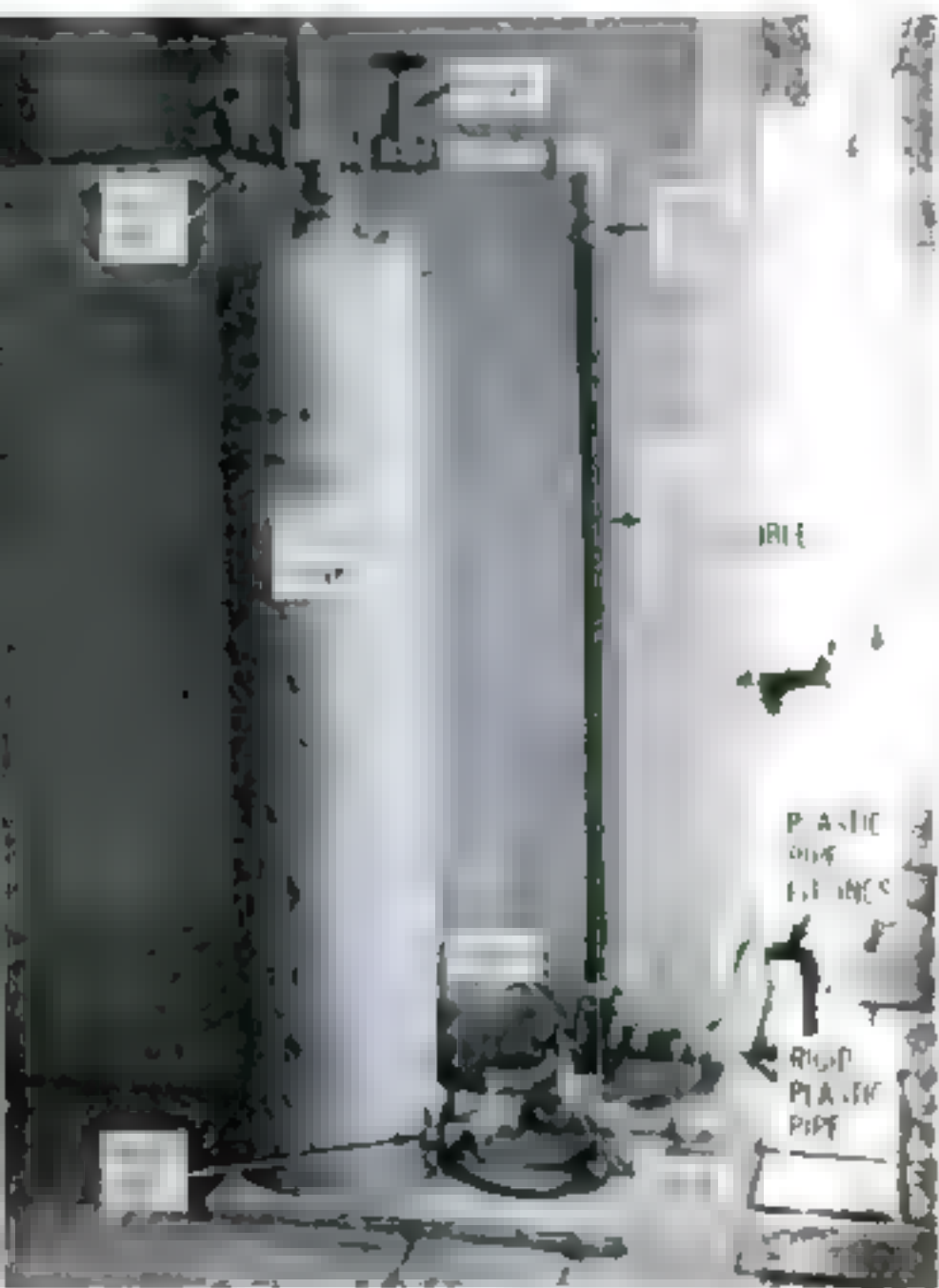
About once a week, or when the flow of water through the filter seems to diminish in velocity, backwash the filter to remove the dirt trapped in the tank. Close both valves and open both hose bibs. Connect



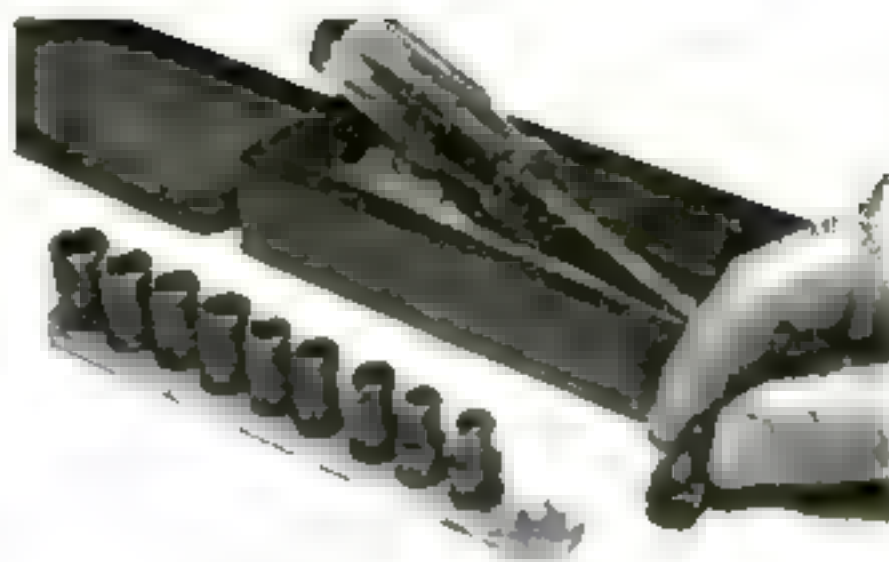
a hose from a faucet to the lower hose bib, and run a second hose from the top hose bib to the nearest drain or sewer.

Turn on the water and watch the drain hose; you'll be amazed at the amount of dirt being washed out. When the water runs clear—after about 10 minutes of flushing—close the hose bibs and open the valves to set the system for filtering whenever the pump is turned on.

Dirt that has settled on the bottom of the pool can be removed by connecting a vacuum-cleaner hose and nozzle to the pool's outlet pipe and turning on the pump. The suction of water being drawn into the filter through the vacuum-cleaner hose will pick up sediment as you run the nozzle over the bottom.

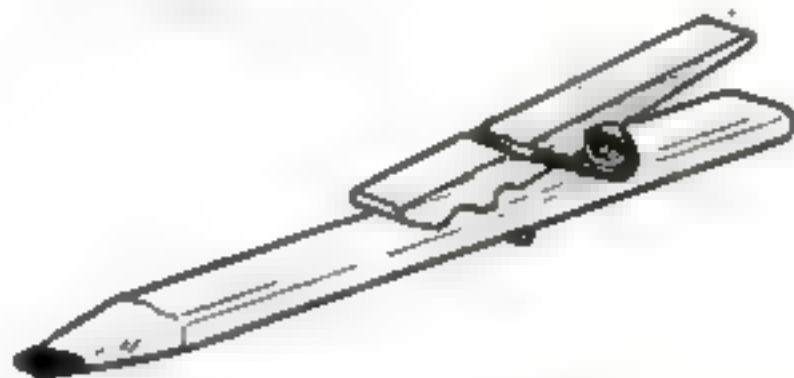


CONNECTIONS MAY VARY, depending on the type of tank used, but the basic arrangement illustrated above should be followed. Filter and pump are mounted on a plywood platform. A removable plywood cover, shown below, has vents for air circulation around the pump motor.



Rack Holds Wrench Sockets

WRENCH sockets can be kept in neat order if you store them on short $\frac{1}{4}$ " dowels glued into a wood base. Cut the base strip to fit the original compartment that held the drivers in a jumble.—Robert Hertzberg, Douglaston, N. Y.



Pencil Clip From Clothespin

YOUR carpenter's pencil won't slip out of your pocket every time you bend over if you fit it with this grip. Remove one leg from a spring clothespin and clamp the pencil in its place. You can then clip the pencil easily to your pocket.—Ann Zawistowski, Coon Rapids, Minn.



Quick Sharpener for Chalk

THIS easy-to-make sharpener puts a sharp point on chalk and also catches the dust. Cut a rectangular opening in a cigar-box lid or other small box and staple a piece of window screen across it.—Daniel Bousha, Jackson, Mich.

Short Cuts and Tips

FROM PE READERS



Jig Spots Cabinet Handles

AFTER finishing some cabinetwork, I had many door handles to attach. To make the job easier and to assure accuracy, I made an L-shaped jig that would place them in uniform position. Cross blocks rest against the door edges and do not interfere with flipping the jig over for the facing door.—*R. J. De Cristoforo, Los Altos Hills, Calif.*



Faster Cleanup for the Shop

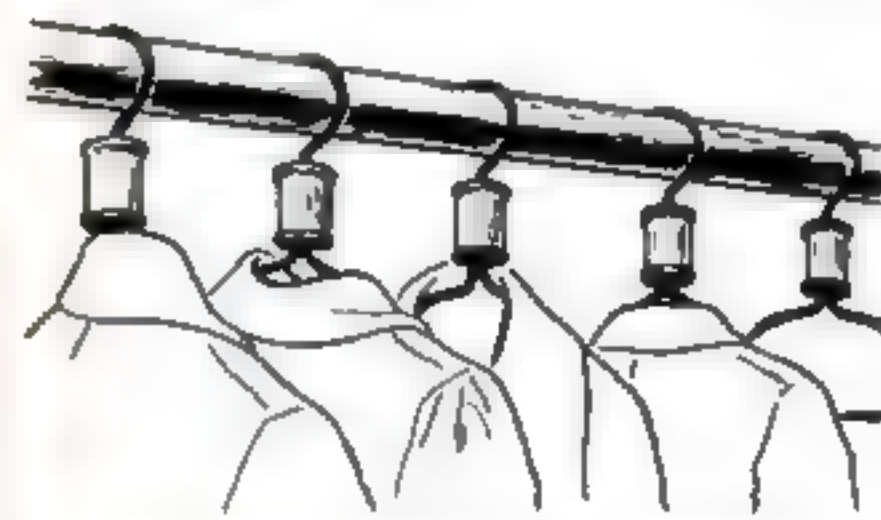
THE semicircular plastic litter basket that's sold for car use is also ideal for shop cleanup. Its flat side fits perfectly against the edges of benches and tables so waste can be swept in. When not in use, the container hangs on a wall.—*Arthur R. Tanner, Poughkeepsie, N. Y.*



Cutting Circular Gaskets

HERE'S how to adapt a circle cutter with a square shank to cut gaskets of many sizes. Remove the cutting bit, and on its opposite end grind a gasket cutter—a thin double-edged blade with a rounded point similar to the cutting spur on a wood bit. To use the tool, tack the gasket material down lightly on a wood surface.—*O. A. Nelson, Seattle.*

▶▶▶I've found that a rubber band wrapped around the joint in a socket wrench will hold the swivel rigid when you're inserting the socket into a hard-to-reach spot.—*William Biewer, Sullivan, Wis.*



De-Tangling Clothes Hangers

HERE'S a simple trick you can use that will keep those pesky wire clothes hangers from jamming together in a tangled mass in your closet.

Slip empty thread spools down over the necks and they'll space the hangers.—*Ann Zawistowski, Coon Rapids, Minn.*

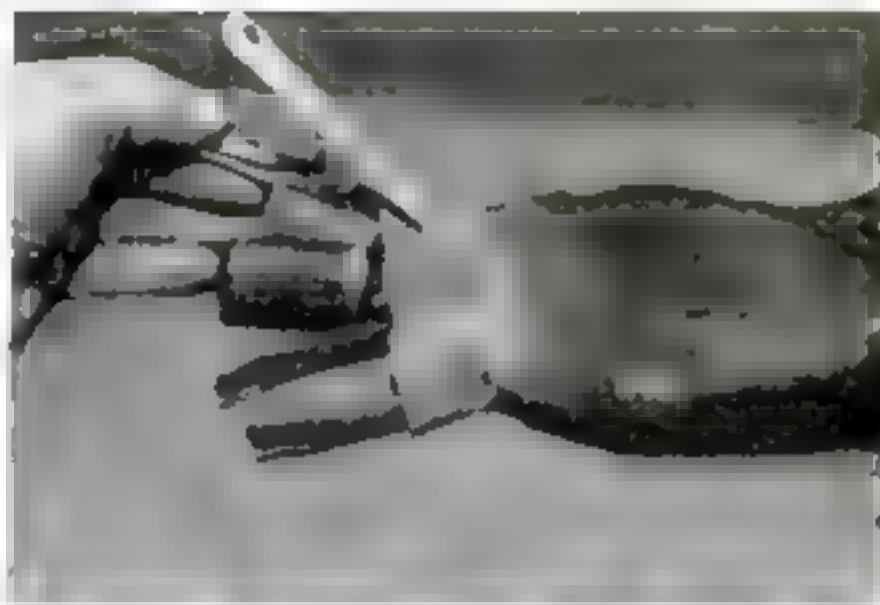


Tips for Keeping Your Car Tidy

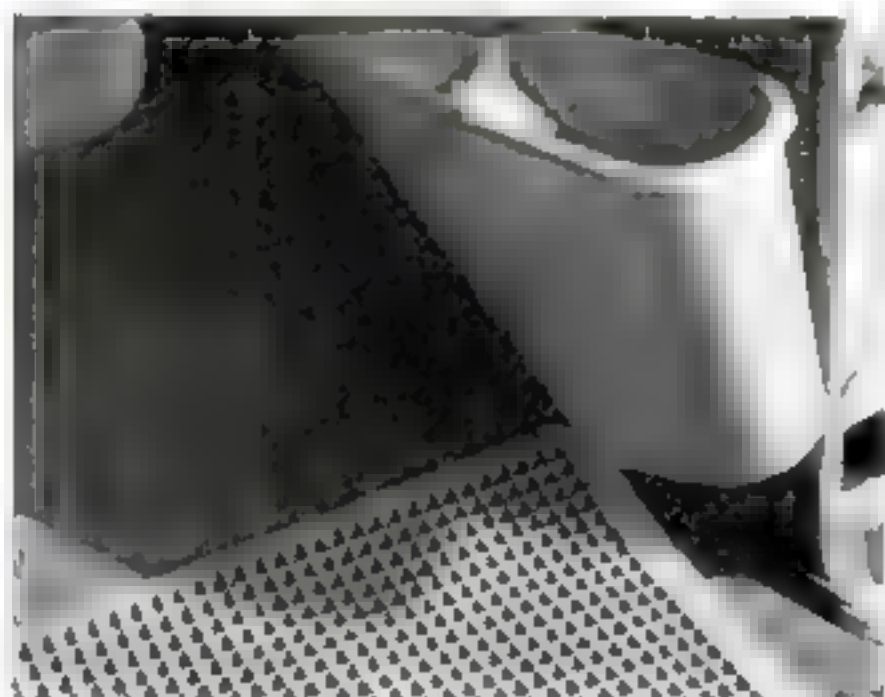
KEEP A BROOM HANDY and you'll be more apt to take time to sweep out sand and other dirt. A whisk broom is good, but an old floor broom with a cut-down handle also does a fine job.



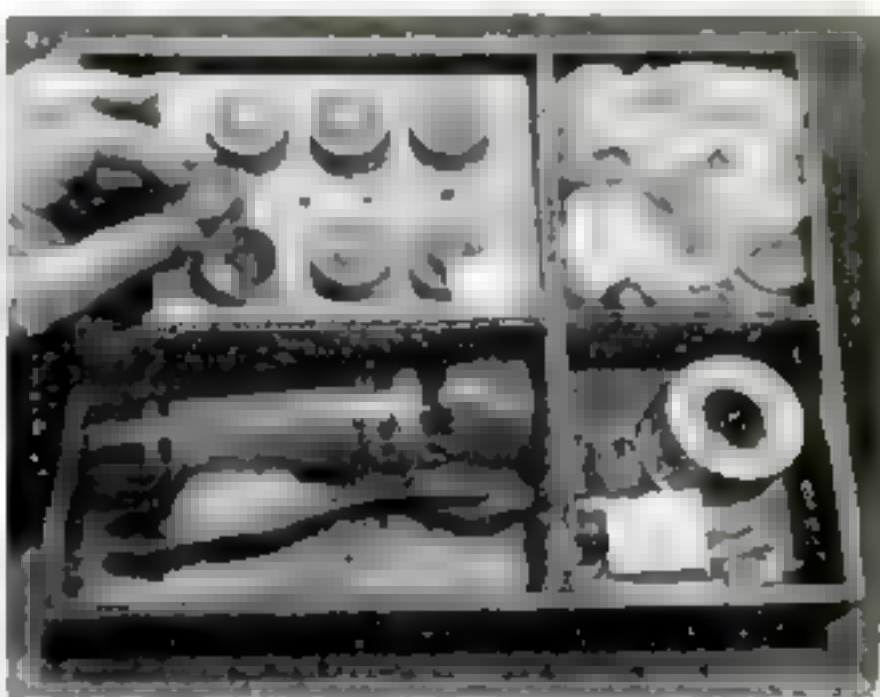
A PLASTIC TRAY to hold sunglasses, smokes, and other small items can be bought at auto-accessory stores. Magnets on the base keep the tray in place on the ledge above the dash.



A WORK GLOVE is a handy place to store such small tools as a screwdriver and pliers. You can sometimes clip it up out of the way—with the other glove—inside the car trunk.



A WASTEBASKET for every car ought to be the rule—in view of the stiff littering penalties now imposed in many states. You can buy a narrow plastic basket like this one.



FOR ALL THE ODDS AND ENDS, a very shallow box usually will go under the front seat. This one is an old desk tray fitted with cardboard partitions.—Glen F. Stillwell.

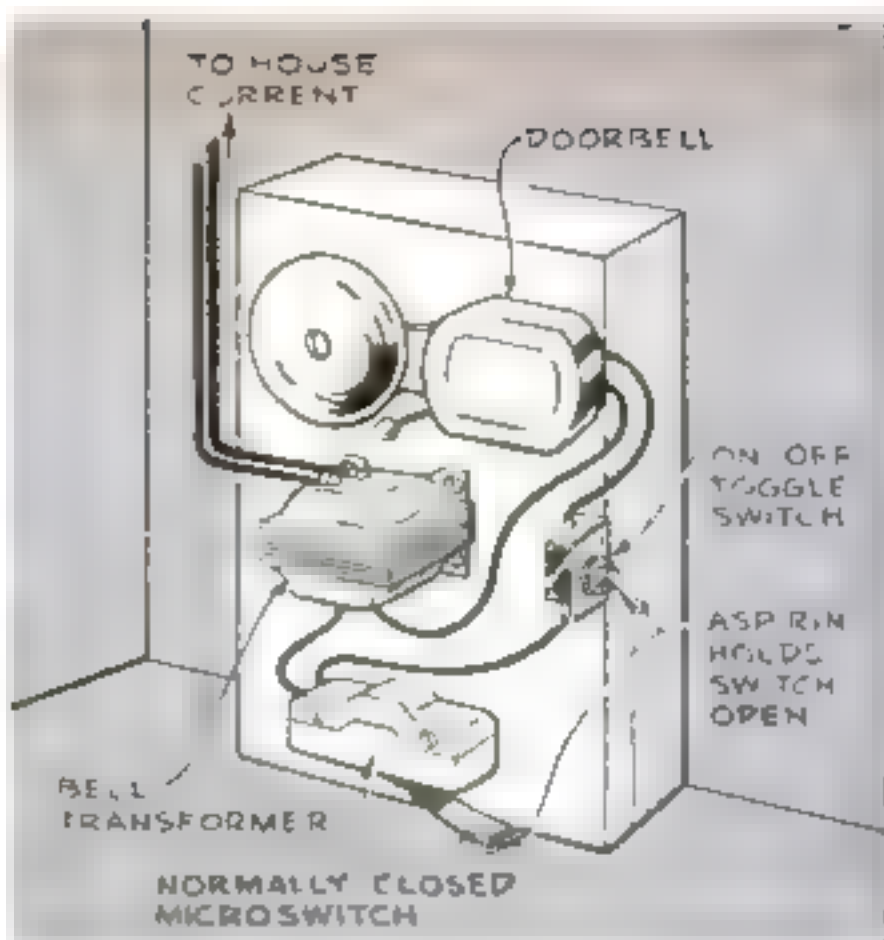
Short Cuts and Tips

FROM PS READERS



Hot Box for Tile Removal

AN ELECTRIC heater makes quick work of removing damaged floor tiles—without injury to adjoining tiles. This one was built by Roy A. Sutherland of Huntington Beach, Calif., for about \$19. It's a five-sided sheet-metal box, 3" deep. The open bottom is 9" square, to cover a standard tile. A switch box mounted on one side controls the heating coils fastened beneath the top. The unit is picked up by its wooden handle, positioned over the damaged tile, and plugged in. Its heat quickly and thoroughly softens that tile (and its adhesive) without affecting adjacent ones. The box is removed and the heated tile is easily lifted out with a trowel.—*W. R. Kreh, Silver Springs, Md.*



Alarm for Wet Basement

WITH this simple alarm, you can detect the presence of water in your basement before it covers the floor.

Mount a normally closed microswitch on a block of wood fastened to the wall so that an aspirin tablet placed between the floor and the arm of the switch will hold the arm in the open, or "off," position. Wire the switch to a doorbell hooked up to a low-voltage transformer.

At the first trace of water, the aspirin will dissolve, permitting the microswitch arm to move to the "on" position. This will sound off the alarm bell. It's a good idea to include a toggle switch in the circuit so that you can shut off the bell.—*Newton G. Noell, Poughkeepsie, N. Y.*



Outdoor Fireplace Is Easy to Build

You don't have to be a mason to build this outdoor fireplace. Just pile 32 cinder blocks on top of each other and add shelves from an old ice box or oven to serve as the grille.

To raise the fire to convenient cooking height, fill the inside of the fireplace with rocks or coarse gravel flush with the top of the second course of blocks. Openings between the blocks at the sides provide ample draft.—*John Michel, Greenwood Lake, N. Y.*



Why do you see Coleman outing products as thick as wild flowers in every roadside park? Maybe it's because cook-out vacations are more fun. You stop where you like, when you like. Maybe it's because you *save*. In most cases, the savings buy your gas for the whole trip. Figure it out. Three restaurant meals a day versus buying at supermarket prices and cooking it yourself. Or, maybe it's because Coleman products have proved themselves millions of times over. For 60 years, in every climate, all over the world. Why don't you take a Coleman vacation?

Camp Stoves, 2 & 3 burner models, from \$15.95 Snow-Lite® Coolers, 2 sizes, aqua, pink, green, from \$15.95* Snow-Lite® Jugs, 1 and 2 gallon sizes, 15 models, from \$4.98* Famous Coleman Lanterns from \$15.50**

*Suggested retail price

The **Coleman** Company, Inc. / Wichita 1, Kansas

New Ideas in Photography



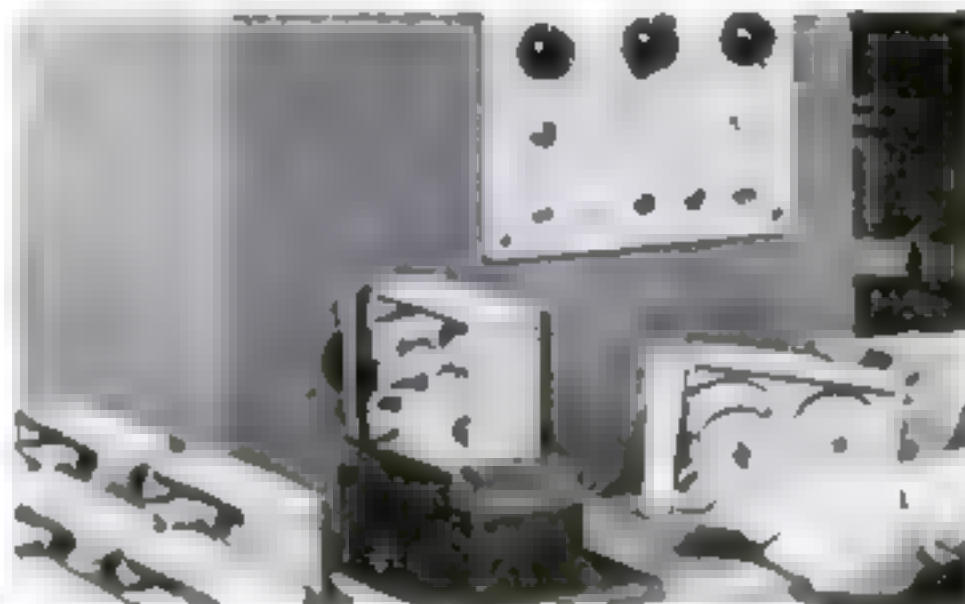
BROWNIE 8 MOVIE CAMERA, f/2.7, outperformed cameras that cost much more.



ELECTRONIC CONTROL is used to "zero" lens into exact setting for clearest, sharpest movies.



SINGLE-UNIT precision body assures dependable performance—costs more per ounce than metal.



ELECTRONIC FRAME-COUNTER checks film travel—assures movies that move at correct speed.

Kodak creates low-cost movie camera that outperforms its price

Quality 8mm movies—from a camera that costs less than \$27? Sounds impossible—but it's a fact!

In side-by-side tests, Kodak's Brownie 8 Movie Camera, f/2.7, outperformed movie cameras that cost much more. Movies were sharper, clearer, steadier.

The secret? Modern materials, modern skills.

First, Kodak engineers created a new camera mechanism—with fewer moving parts—that does a better job than older, complex mechanisms. Rugged, too; less likely to get out of adjustment.

Next, they selected a wide array of modern

man-made materials, each to do a superior job. The Brownie 8 Movie Camera actually has 27 non-metallic parts. They cost more than metal, ounce for ounce, but they permit precision fabrication without the penalty of high assembly cost.

And finally, the engineers devised a mechanized assembly system, with electronic set-ups that maintain precise inspection and high performance standards.

Examine a Brownie 8 Movie Camera. It will give you up to 40 average-length scenes on each roll of 8mm film. Best of all—for less than \$27—it will bring you the thrill of your own top-quality movies!

from Kodak

New automatic cameras solve old problems of summer action

Two Kodak automatic 35mm cameras are bringing new freedom to summertime picture-taking—where action is fast and conditions change quickly.

The Kodak Motormatic 35 Camera and Kodak Retina Automatic III Camera not only set the exposure for you automatically—they also let you select fast shutter speeds to handle fast action. And the Motormatic 35 Camera even advances the film for you—keeps you always ready for the next shot!

Fast action is only one summer problem—when picturing sports or frolicking kids, for example. Variable light is another—as when clouds are passing across the sun. And going from sun into shade is a third.

Fast shutters . . . electric eyes

The Kodak Motormatic 35 and Retina Automatic III Cameras handle all these situations easily. On the Kodak Motormatic 35 Camera, you can set the shutter up to 1/250—on the Kodak Retina Automatic III Camera, all the way to 1/500 second.

And each camera has an electric eye which reads the light continuously. When you press the shutter release, your lens instantly sets to the right opening.

Manual setting, too

If you wish, you can set either camera manually. The Kodak Retina Automatic III Camera also has a precision lens-coupled rangefinder for measuring distance. And the Kodak Motormatic 35 Camera has a special linkage for flash shots—as you change focus, the lens opening automatically adjusts for correct flash exposure.

Examine these remarkable ultra-modern cameras. One is just right for your kind of summer picture-taking.

See your dealer for exact retail prices. Many dealers offer terms as low as 10% down.

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

See Kodak's "The Ed Sullivan Show" and "The Adventures of Ozzie and Harriet"

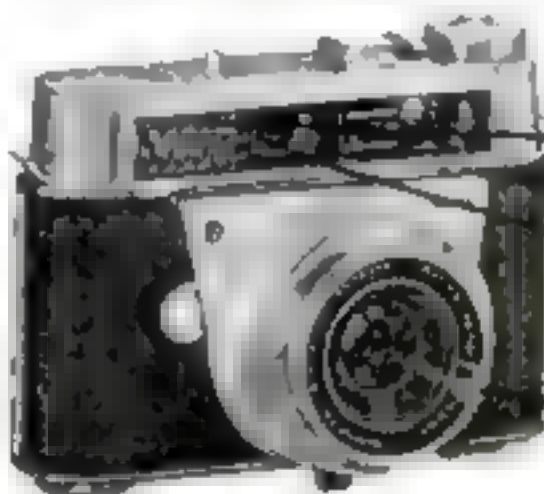


Electric eye sets lens for you

Flash link makes indoor shots easy

Motor drive winds film automatically

KODAK MOTORMATIC 35 CAMERA can take 10 shots in 10 seconds! After each shot, a tiny spring motor swiftly advances the film, cocks the shutter. Fast f 2.8 lens. Fully automatic lens setting. Full manual control. With this camera, you can keep your eye glued on the action, ready for the best shots, no matter how fast they come. For flash pictures 5 to 25 feet from subject, setting focus automatically sets correct lens opening. Less than \$110.



Electric eye sets lens for you

Rangefinder for precise focusing

Manual control for special uses

KODAK RETINA AUTOMATIC III CAMERA has superb Retina Xenar f.2.8 Lens. Fully automatic exposure setting, with override for manual control. Fast single-stroke film wind. Coupled rangefinder. Depth-of-field scale. ASA film settings from 10 to 1250. Shutter release locks if light is too dim or too bright. Less than \$130.

Now—snap fast action in color!

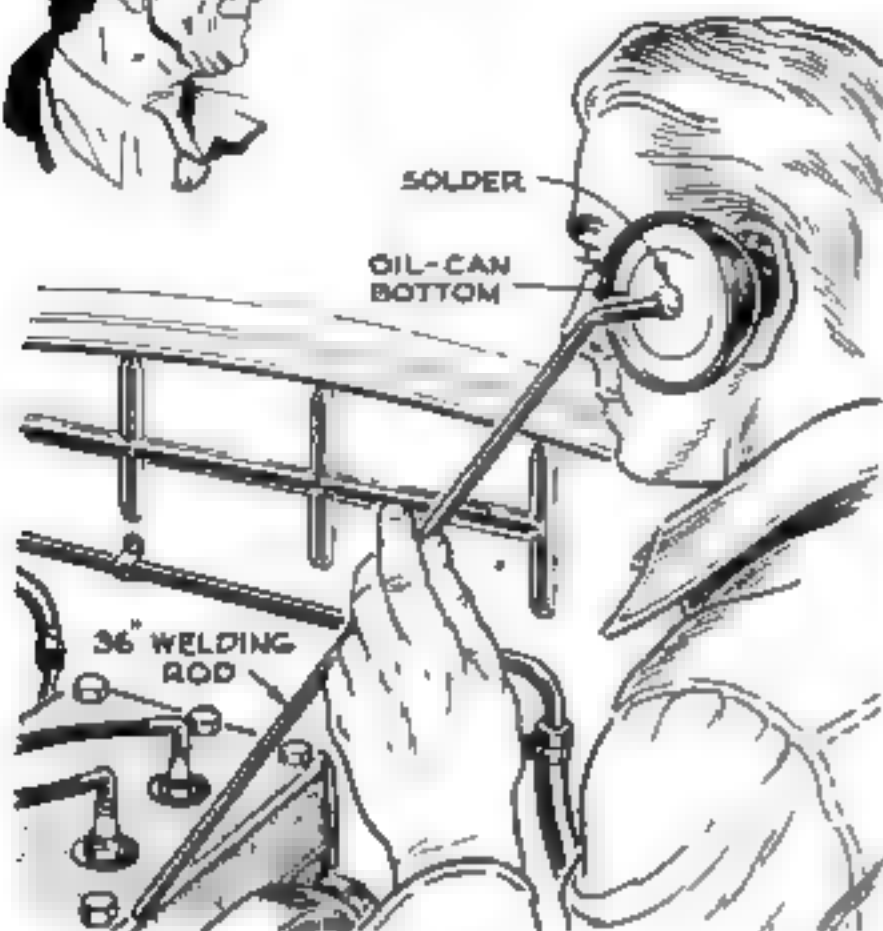
This weekend, start exploring the new picture possibilities opened by Kodak's ultra-fast 35mm color film, *Kodak High Speed Ektachrome*. With a sizzling daylight index of 160, it lets you take action shots in color that once were out of the question. Lets you get greater depth of field. Permits many indoor available-light shots with the camera handheld. Try it!

Prices subject to change without notice.

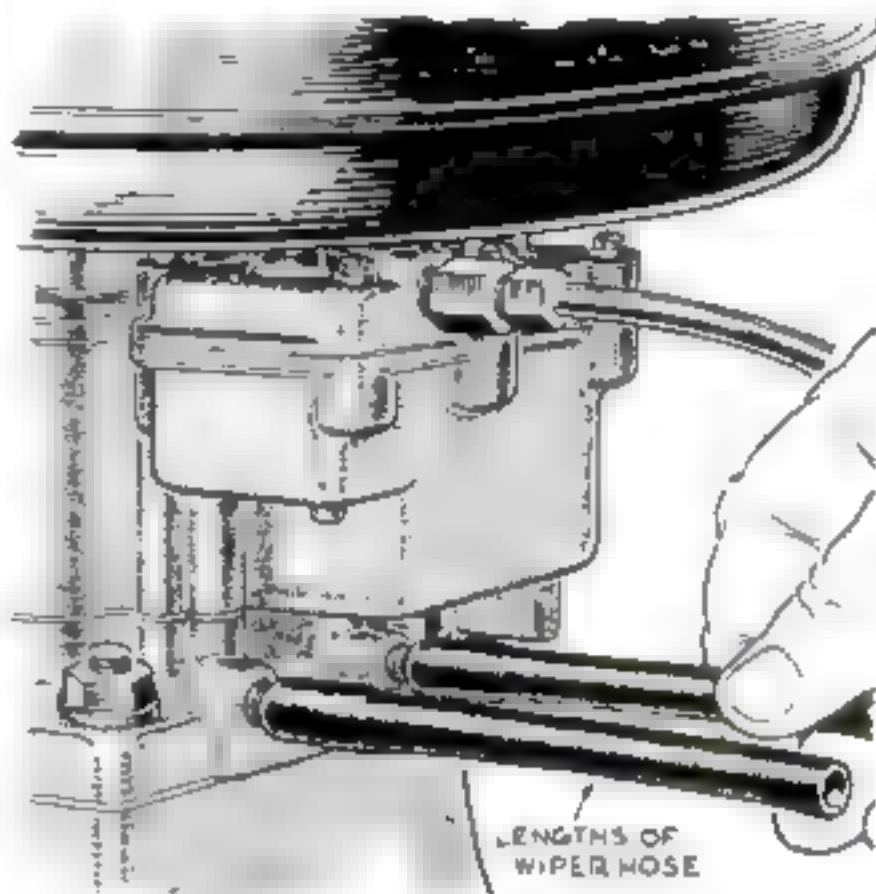
Kodak
TRADEMARK



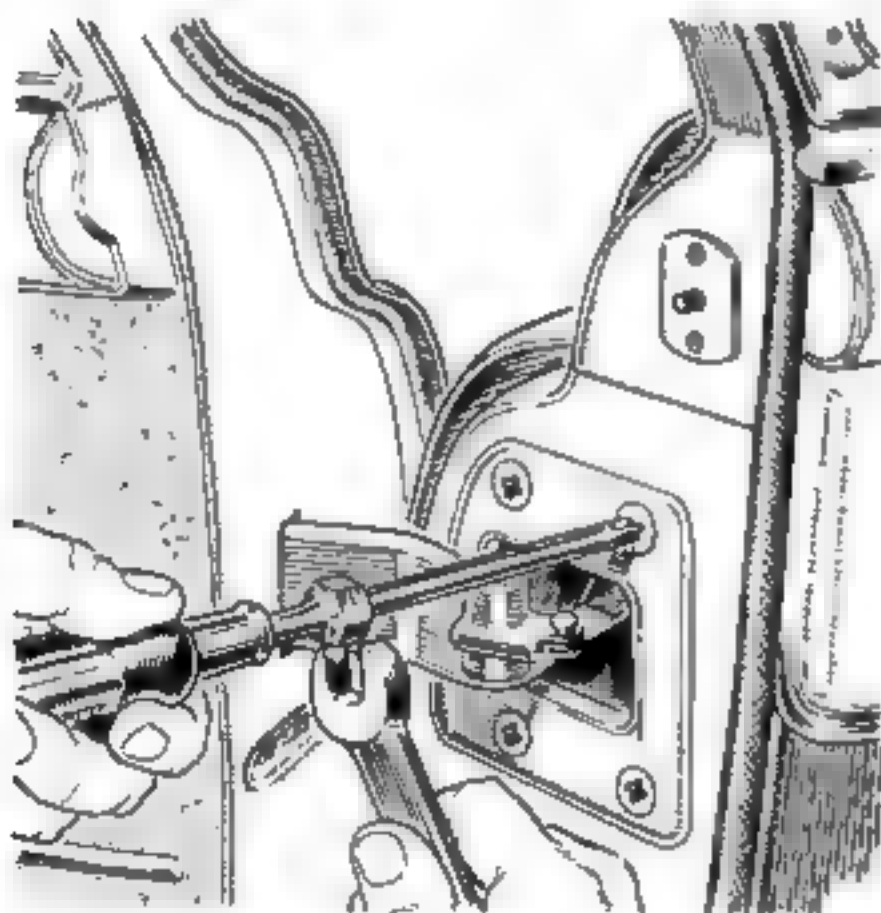
Hints from the Model Garage



Want a homemade stethoscope that will help you track down engine noises? It's easy. Bend one end of a long rod and solder it to the bottom of an oil can. The can bottom acts as a diaphragm, amplifying the slightest sound.



A good idle-mixture adjustment sometimes changes when the air cleaner is put on. A more precise adjustment can be made with the cleaner on the carb by slipping hose over the adjusting screws. Twisting the hose turns the screws.



Extra leverage can be applied to a screwdriver with a nut welded on its shank. Press the screwdriver firmly into the screw slot and turn the nut with a wrench. The most stubborn screws can be removed this way without damaging them.



Handy hangers can be installed in your car at convenient locations without drilling holes. Use the plastic hooks with adhesive backing sold in dime stores. They come in various colors, and will stick to almost anything in the car.



Especially designed for boating

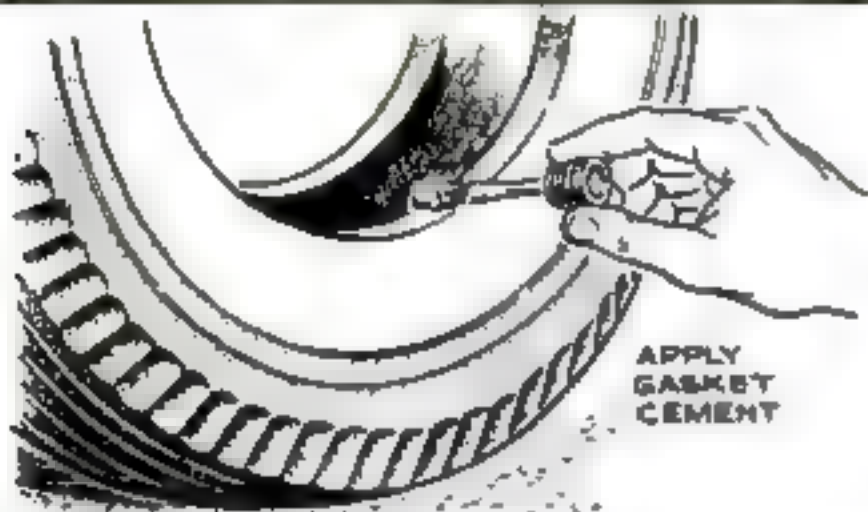
WATERPROOF PACK KEEPS YOUR SPARE CHAMPIONS CLEAN AND DRY—ALWAYS!

That's just one reason for making Champion your choice for spare—as well as "in use"—spark plugs. Other reasons? Champion's rust-resistant plating. The attached gasket that never falls off. Champion's winning performance. All this—at no extra cost! No wonder even major outboard maker uses Champions. So always carry spare Champion spark plugs.

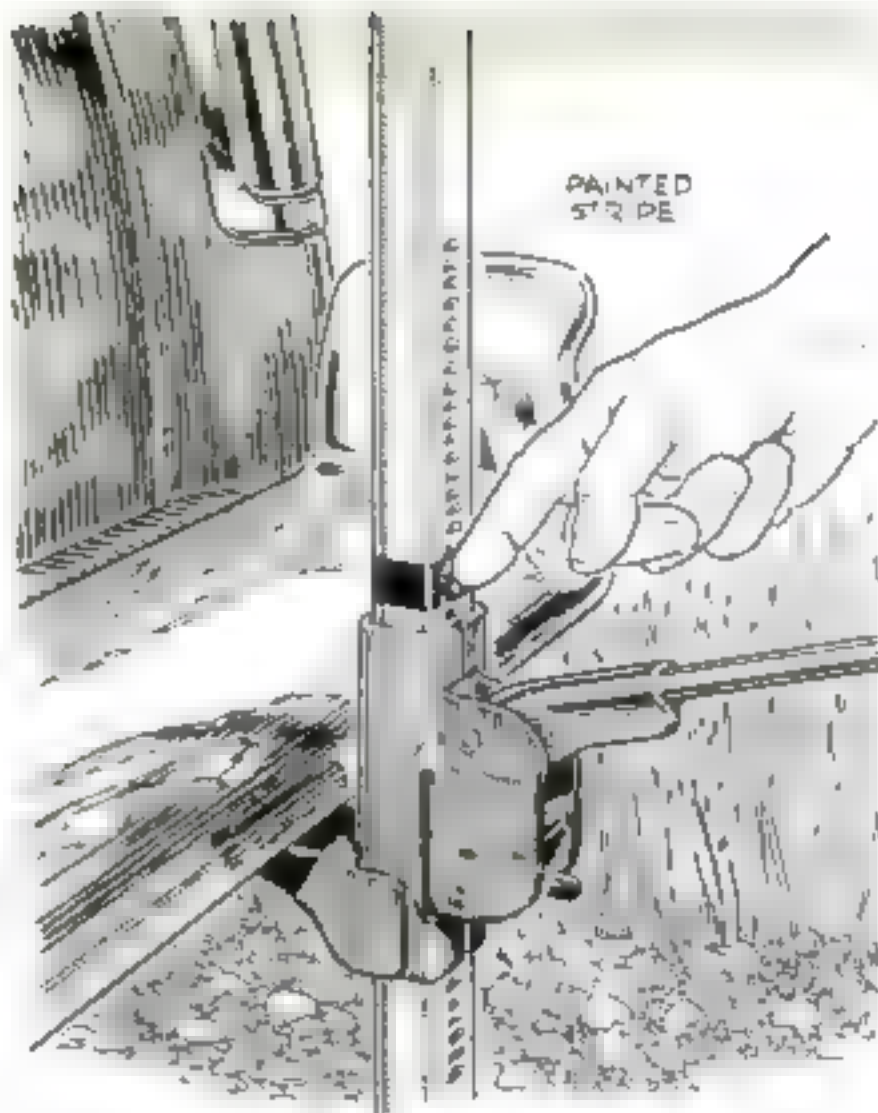
CHAMPION

CHAMPION SPARK PLUG COMPANY • TOLEDO 5, OHIO

More Hints from the Model Garage



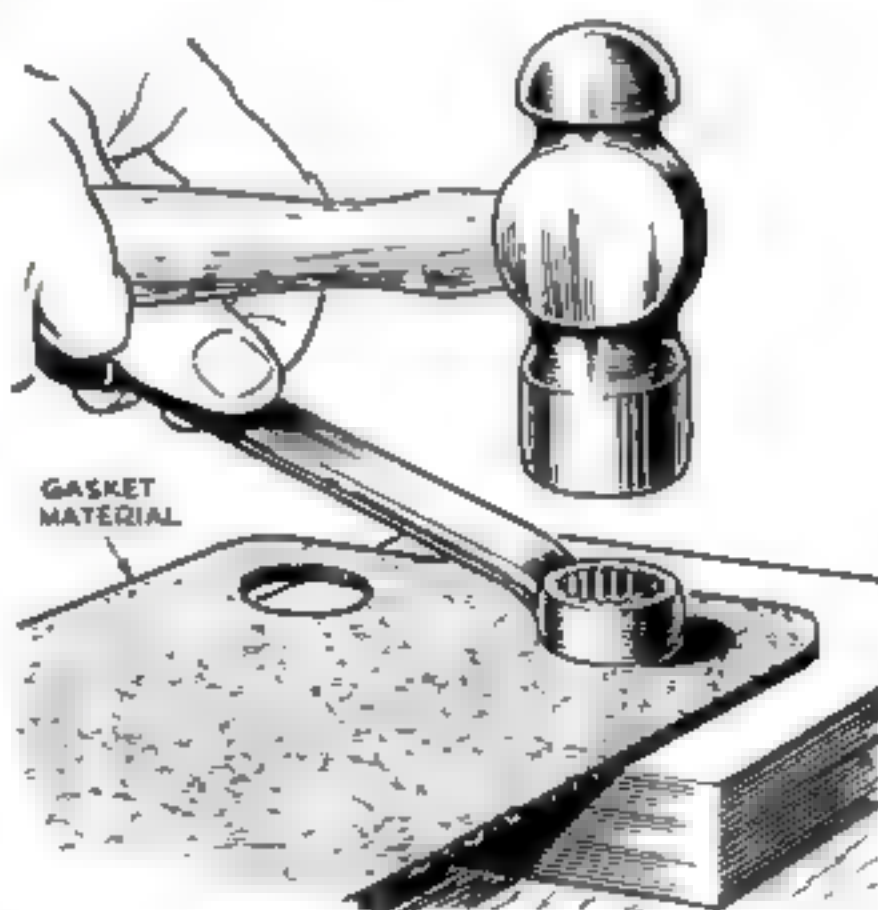
Tubeless tires that leak at the bead can be made airtight by cleaning the wheel rim and applying gasket cement to the rim and the tire bead. Overinflate the tire about 10 pounds to insure a good seal, then reduce pressure to normal.



After taking off a flat tire, many motorists find they must jack up the car another inch or two in order to put on the spare. You can avoid this hazard by marking the proper height on the jack stand and raising the car to the mark.



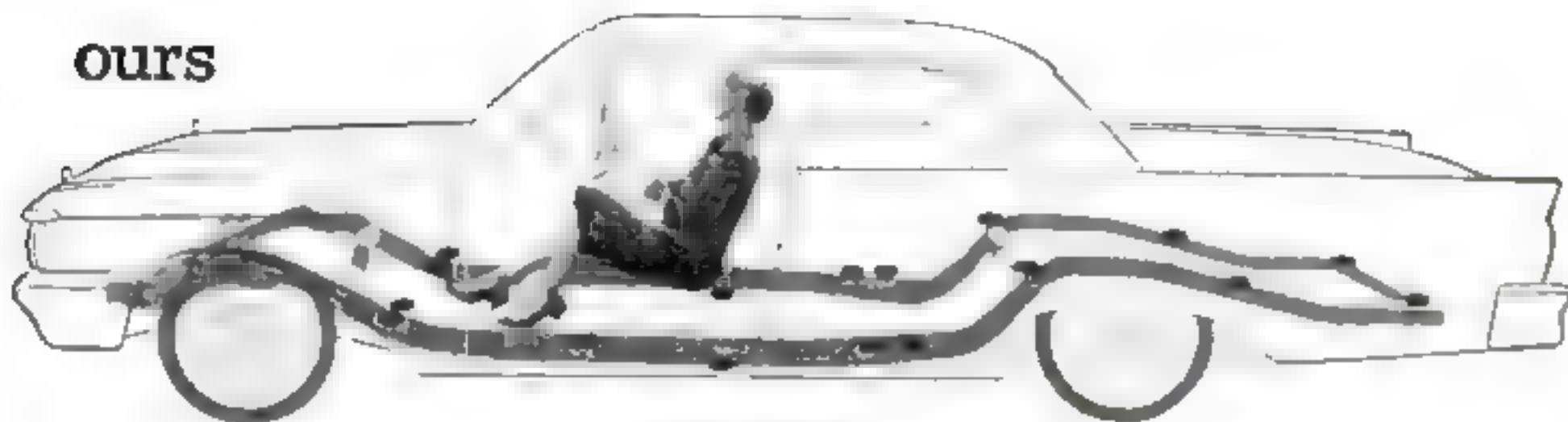
Radiator hoses—especially those at the bottom of the engine—deteriorate rapidly because of oil and dirt that accumulate on them. You can prolong their life by wrapping them with aluminum foil to keep them clean. Tape the ends of the foil.



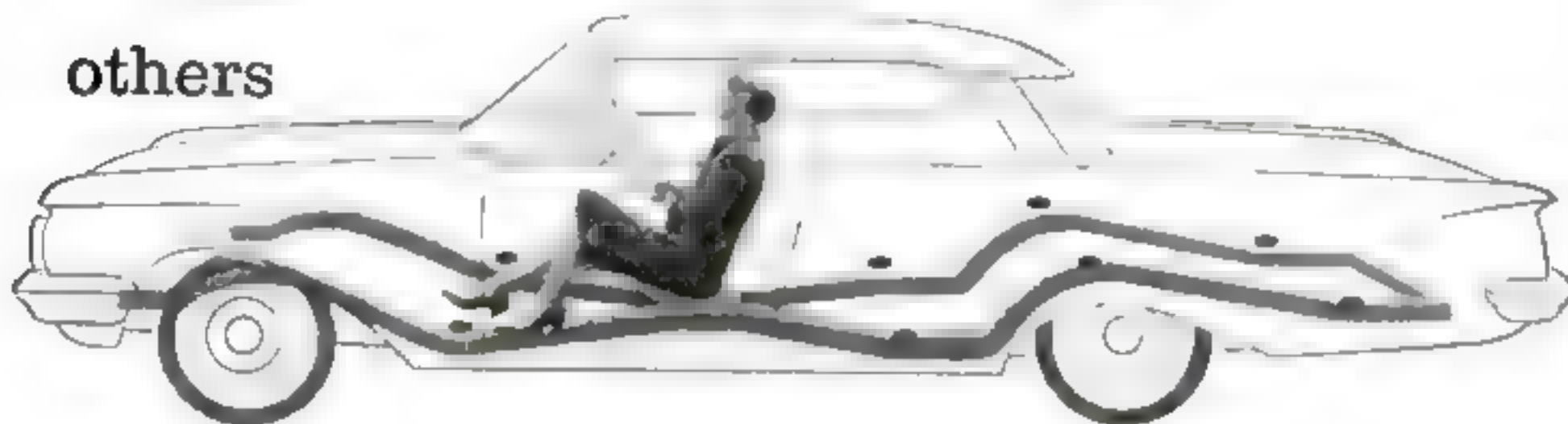
Holes can be punched in gasket material with a box wrench. Place the sheet on an anvil or other hard surface, hold the wrench in position, and tap it lightly with a hammer. To punch out a washer, use a small wrench followed by a larger.

Which ride is quieter?

ours



others



**There are 50% more rubber body mounts
in the 1961 Ford Family of Fine Cars**

Ford Motor Company builds better bodies

- Rubber body mounts are used to seal out road and engine noise. They prevent it from being transmitted into the car. The more rubber body mounts, the more effective the sound barrier. In the Ford Family of Fine Cars, with 50% more insulating body mounts, you get a remarkably quiet ride.

- Also adding to the silence of the ride is extra sound insulation.

In the Ford Family of Fine Cars there is up to 57% more area covered with sound absorption material.

- Millions of car frames are shaped like an "X." Weak in the middle, they can be twisted out of shape. Guardrail frames in the Ford and Mercury cars curve out. They are strong in the middle. Guard rails also protect passengers in the unitized bodies of Falcon, Thunderbird, Comet and Lincoln Continental.

- Doors in the Ford Family of Fine Cars are stronger. They are

braced with steel ribs. This means they are more rigid and therefore close tighter and quieter. They are less subject to distortion, reducing the likelihood of developing squeaks and rattles.

These are four of the many reasons we think you will find (upon comparing our cars with other cars) that Ford Motor Company builds better bodies.



Auto Club of America - Dearborn, Michigan

FORD • FALCON • THUNDERBIRD • COMET • MERCURY • LINCOLN CONTINENTAL



Gus eyed the sealed envelope dubiously. "So now you want to put an old-time grease monkey like me on the spot."



Gus Separates the Men from the Boys

By Martin Bunn

IT WAS Stan Hicks who was responsible for putting his boss, Gus Wilson, and the Model Garage on a spot. One Saturday he attended an open-house demonstration put on by the auto-mechanics class at the high school. As the boys worked on several cars, Herb Findley, the instructor, proudly explained that they were using the latest test equipment to locate troubles.

"Guess they'd be lost without all those fancy gadgets to tell them what's wrong," Stan said.

Findley rubbed his chin. "You may be right. I know Gus Wilson has all these trouble-shooting devices, but in an emergency he can do without them."

Stan nodded. "He sure can, Mr. Findley. If these kids could see . . ."

"You've read my mind," broke in the instructor. "If my boys could watch an old-time mechanic like Gus . . ."

That was when Stan's pride in his boss got the best of him. As he went into an excited huddle with Findley, the Model Garage owner at the other side of town was whistling as he worked, blissfully unaware of what was in store for him.

AS STAN opened the Model Garage on Monday he dreaded the arrival of his boss when he'd have to break the news.

"Beautiful day," Gus greeted him when he strode in. "What's the matter, Stan? You look sort of down in the mouth."

Stan grinned weakly. "Well, Boss, I might as well get it off my chest." And

he told about the plan he'd cooked up. "Let me get this straight," Gus said as he filled a pipe. "Over the weekend Herb Findley and his auto-mechanics class diagnosed the school's balky old station wagon, using all their testing equipment. And then you committed me to compete with them."

"That's right, Gus—but using no modern testing gadgets to help. Just old-time trouble-shooting know-how."

Gus groaned. "Those are smart kids."

"I know," Stan said, "and here they come. We can't back out now."

"Well," Gus spluttered "I've a good mind to let you . . ."

"**A**H, THERE you are, Gus," said Herb Findley, climbing out from behind the wheel of the station wagon, followed by eight eager youngsters. "Has Stan told you about our little proposition?"

"Yes, Herb, he sure has," Gus said. "Great little helper, Stan is."

"It was his idea, all right," said Findley, not catching the sarcasm in Gus's voice. He pulled an envelope from a coat pocket. "Here are the individual conclusions of these eight students. Each boy checked the car out unaided except by the school's test equipment."

Gus eyed the sealed envelope dubiously. "So now you want to put an old-time grease monkey like me on the spot."

"Oh, no, Mr. Wilson," protested a carrot-topped boy. "Stan says you can just sniff the exhaust, look into a carburetor, and tell what's wrong."

"Yeah," chimed in a tubby youngster. "We want to see how you do it."

"All right," said Gus. "Start her up."

One of the boys slid behind the wheel and started the engine. Gus lifted the hood and listened.

"Be right back," he said, and disappeared. When he came back he was

chewing gum and carrying a strip of newspaper. He attached the paper to the end of the exhaust pipe with his wad of gum.

As he watched the paper flutter in the exhaust of the idling engine, Stan caught a twinkle in his boss's eyes. Gus was beginning to enjoy himself.

"Aw, quit giving us the business," said one of the teen-agers, "and start making like a mechanic."

"Don't rush me, boys,"

Gus said, walking to the front of the car. "We old time mechanics are sort of slowpokes." As he spoke, he shorted each spark plug of the in-line engine with a screwdriver. He did a repeat, and stopped the engine. Then he moved to the bench, pulled out a drawer, and dug around in it.

"Probably looking for his divining rod," suggested one of the students.

"Now, how did you guess," Gus said, coming up with a spark-plug body. The porcelain had been removed and an inner-tube valve was brazed in its place.

As the boys nudged each other, whispering, Gus put the stick-shift

car in gear. Next he removed the Number 2 spark plug, rocked the piston on top dead center, and screwed the tire-valve spark plug into the cylinder head.

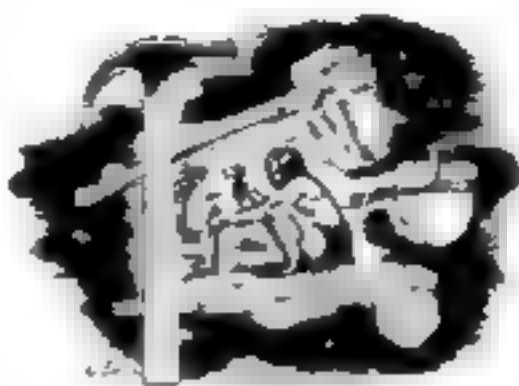
"Bring over the air hose," he called to Stan. "Now, hold it on the valve stem of this plug and turn on the air."

As Stan fed air into the cylinder, Gus moved to the back of the car, leaned over, and listened. Back at the engine he took off the oil-filler breather cap. After a brief look he removed the radiator cap and peered inside, using his pencil flash.

"Okay, Stan, turn off the air," Gus said, removing his trick plug and putting back the original and the ignition wire.

"That's it," he said, as he wrote on a piece of paper and put it face down on

Where'd it come from?



THE HAMMER. The nearest rock was man's first striking tool. Later, Stone Age man used a rounded stone to flake other stones into a hammer shape, and tied on a handle. The handle was made more secure when Neolithic man learned to make shaft holes. The first metal hammers of modern form appeared about 1500 B.C. By early Roman times, the familiar claw hammer was in the carpenter's kit.

exclusive
AC "hot tip"
insulator




provides self-cleaning action
and sure-firing power at all speeds

AC Fire-Ring Spark Plugs offer extra miles of sure-firing power.

AC's Hot Tip insulator, uniquely designed and of near-diamond hardness, provides a thin, recessed tip that *heats faster* to burn away harmful deposits. This self-cleaning action means full-firing power at

all speeds—for more miles. In addition, the Hot Tip insulator *cools faster*, to prevent pre-ignition.

Ask for AC Fire-Rings—with the exclusive Hot Tip—next time you make a spark plug change in your car or light truck.

AC SPARK PLUG  THE ELECTRONICS DIVISION OF GENERAL MOTORS



Fire-Ring spark plugs

BUILT BEST FOR YOUR CAR, YOUR BOAT, YOUR LAWN MOWER
—EVERY ENGINE YOU OWN THAT RUNS ON GASOLINE

the bench. "Now let's see what's in that envelope of yours, Herb."

FINDLEY was shuffling slips of paper. "Let's see," he said. "Four say the car has a weak compression reading in Number 2 cylinder due to a sticking intake-valve stem. The others agree on the condition of the Number 2 cylinder; but two give the cause as faulty rings, and two blame a burned exhaust valve."

"No question about the cylinder compression," Gus said, "but I don't go along with any of those causes."

Carrot Top picked up Gus's paper and read aloud what Gus had written: "Low compression, Number 2 cylinder, caused

practice it is fairly easy to detect a weak cylinder if the others are good."

Several of the students were taking notes. "Now for the payoff," said one. "How did you rule out valves and rings as the cause of trouble?"

"You all saw what I did," Gus said. "With Number 2 piston on top dead center, I had Stan apply air pressure to locate the leak causing low compression. With a faulty exhaust valve I would have heard it leaking into the crankcase when I removed the breather-pipe cap."

"Two out and one to go," said a youngster as Gus paused to fill his pipe.

The Model Garage owner continued: "When I looked into the radiator and saw air bubbles coming up through the water, I knew I had it. And oil scum on top of the water was a clincher, proving that oil and gas fumes were leaking from the cylinder under compression into the radiator."

Herb Findley looked at his watch. "I guess we've taken enough time. . . ."

"Just a minute," broke in a student. He pointed to the array of testing instruments on a shelf. "Why all that stuff?"

"Couldn't do without it on lots of jobs," Gus said, "specially on today's cars."

The student nodded. "Sure, on testing a coil or condenser, I guess."

Gus smiled. "A man can tell a lot about coils and condensers by how far a spark will jump, its color, and the snapping noise it makes. You just remove the high-tension wire from the distributor, pull the distributor cap, switch on, hold the wire a quarter-inch from the engine block, snap the ignition points with your thumb. . . ."

"Whoa," said Findley. "That's enough for today. And thanks, Gus."

WHEN the visitors had gone, Gus opened the hood of a car. "What seems to be wrong, Stan?"

"Low compression, I think."

"Okay. Hand me the compression tester. Doing it the old-time way is quite a strain on a mechanic."



probably by a leaking head gasket."

Loud protests broke out. "Hold it," Gus said. "I could be wrong, but let me explain how I worked it out."

"First clue us in on that strip of paper over the exhaust," said one boy.

"That was just a gag," jeered another.

"No, it wasn't," Gus said. "If a cylinder had been missing entirely, the paper would have been sucked against the pipe with every miss. But here there was only a break in the flutter, indicating a weak cylinder."

"Makes sense," said the tubby student. "But how did you spot which was the weak cylinder?"

"With my screwdriver. When you short out a spark plug the engine slows abruptly. Remove the short and it picks up power. The changes are stronger in a good cylinder than in a weak one. With



expert training

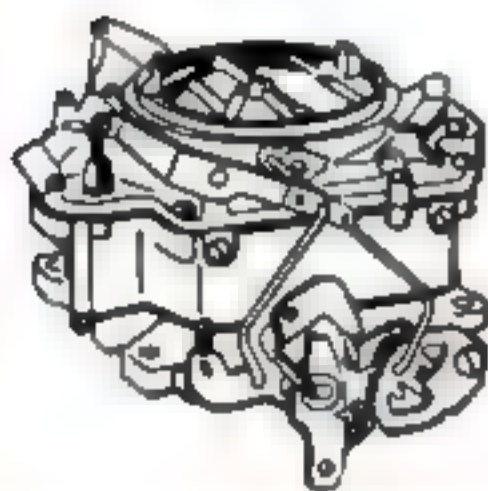
qualifies your Rochester-GM Carburetor Specialist to do the most efficient and reliable job on your carburetor.

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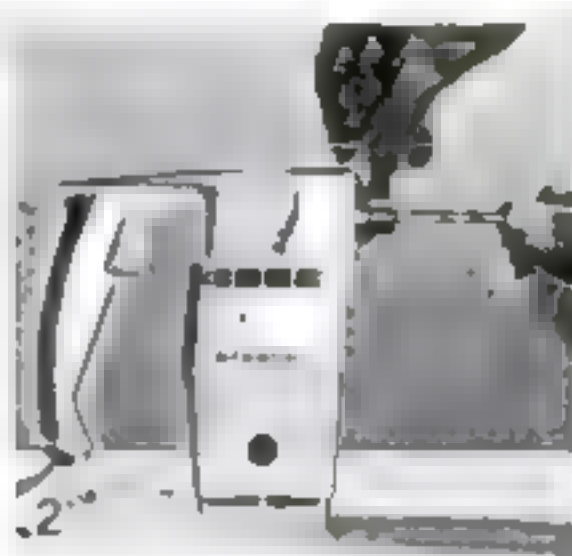


\$30⁰⁰

Only a nickel
more than the
next best drink

power drill like it before: **DisSTON 1/4" DIRK!**

"The unusual design makes sense. With your hand directly behind the bit, you can drill straighter, apply more muscle on tough boring jobs and eliminate the wobble that breaks bits and gives you oval holes," says a Shop-Use Report in Popular Science.



1. POWER. The Disston Dirk has a full 3 amp motor (1800 rpm) with Spiroid® gearing. It's one of the most powerful drills in its price class. These gears have more teeth in simultaneous contact than any other right angle gears. Plus, the Disston drill also has a built-in chip blower — and a three-wire safety cord.

2. EXCLUSIVE! A STAND-UP BASE. It's the only drill with a stand-up base, makes it easier to change bits. Drill bits won't break or bend when you set the unit aside because the Dirk is always in an upright position.

3. YOU CAN SNEAK IT INTO CORNERS. It's the only drill with an offset motor and a recessed Jacobs chuck. This gives the working end the slimmest profile available. You can also work between joists and get closer to floors and ceilings. (Note bit clearance required by conventional drills.)

Look for the new Disston Dirk 1/4-inch drill in your local hardware store. It's priced at \$30.00, only a nickel more than the next best drill. When you see it and try it, you'll want to buy it. The Dirk, made in Danville, Virginia, is another fine product from Disston, master toolmaker since 1840.

PORTER

**DISSTON DIVISION
H. K. PORTER COMPANY, INC.**

Short Cuts and Tips

FROM PS READERS

Locking Pliers Ground a Welder

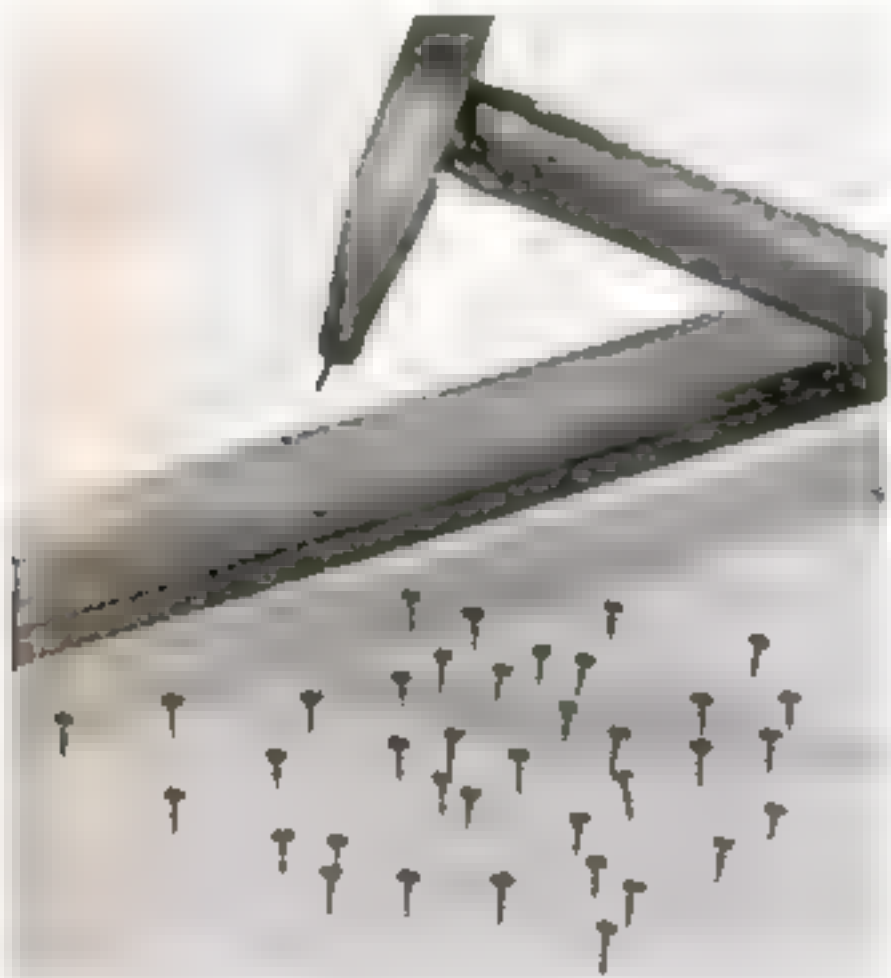
THE ground lead from my welder kept losing contact with the work. Either it would accidentally pull off, or dirt or some other coating would prevent a good ground. After brazing a copper tube to the handle of a pair of vise-grip pliers, I inserted the wire from the ground lead in this tube and brazed it there. Now I just lock the pliers on some handy part



of the work to be welded and know I'll have a good ground until I release their grip.—*John Krill, North Lima, Ohio.*

Window Screen Holds Tacks

INSERT tacks through the mesh of a framed screen and they'll be a whole lot easier to pick up with a magnetic tack hammer. With the heads seated against the screening, you can position them on the hammer for square driving. Also, you can pick up one tack at a time, instead of a prickly bunch, as often happens when tacks are dumped on the bench top.—*Richard Hanscom, Elmhurst, Ill.*



▶▶▶WHEN cutting double-faced plywood (or a hollow door) with a portable circular saw, you may ruin the upper side because the blade splinters the veneer. To prevent this, wipe a wet cloth along the cutting line until that area is well soaked. Saw immediately, before it dries out.—*Phillip J. Shuler, Acton, Calif.*

Magnet Anchors Cloth Tape Measure

YOU can increase the usefulness of a cloth tape measure by cementing a bar magnet at one end of it. The magnet will hold the end of the tape against any steel object, freeing one hand. Also, it will weight the tape for vertical measurements, even when there's no metal to anchor it to.—*Frank Shore, NYC.*



Beautify Your Home with an Easy-to-Build **SUNDECK**



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**FROM YOUR
LUMBER
DEALER**

This booklet describes several easy-to-build sundecks designed by leading architects for economical construction. Each is completely different in style, with a variety of ideas which will not only add to your home's beauty, but help you to get the most out of "back-yard" summer living! All are simply constructed with readily available Western Pine Region lumber.

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IDEAS**



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Enclose 10¢ for handling and mailing.



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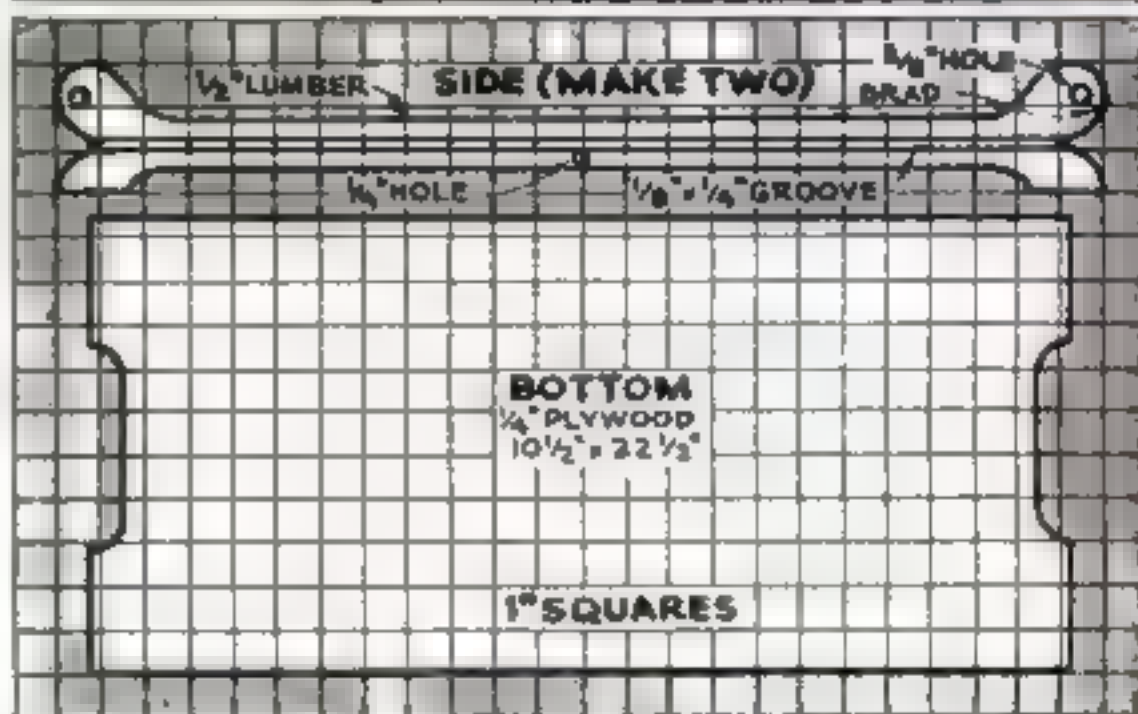
Short Cuts and Tips

FROM PG READERS

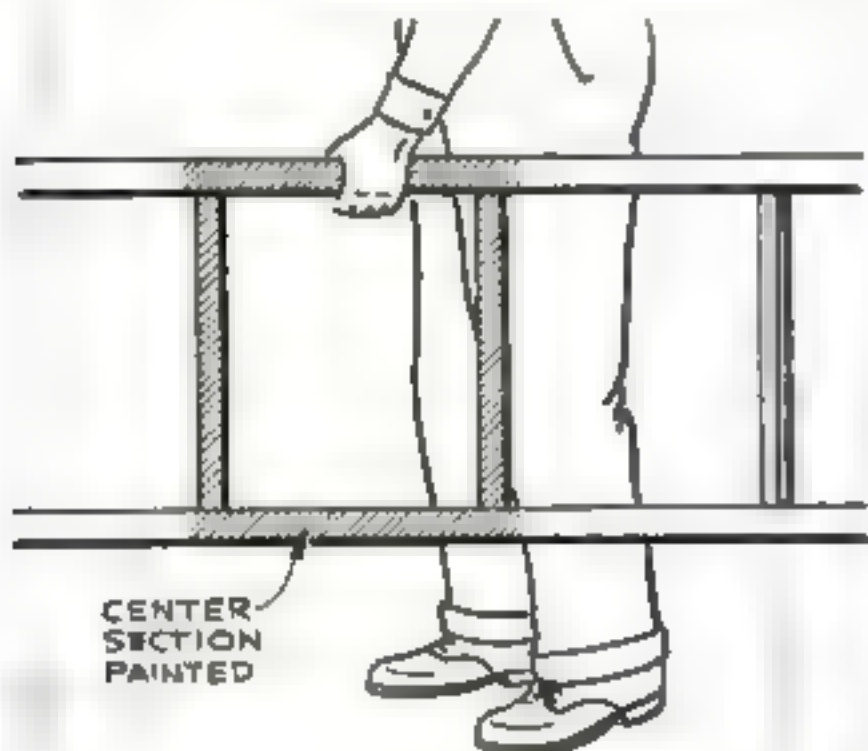
Serving Tray Is One-Evening Project

A PANEL of $\frac{1}{4}$ " plywood, two strips of $\frac{1}{2}$ "-by-3" solid stock, and three dowels $11\frac{1}{4}$ " long are the only materials needed for this useful tray. If a natural finish (such as spar varnish) is to be used, lumber and plywood of contrasting shades will add interest. Or paint the tray two colors.

Groove the side strips before cutting them to shape with a jig- or coping-saw. Then drill holes for the two $\frac{3}{8}$ "-diameter dowel handles and the $\frac{1}{4}$ "-diameter dowel crosspiece that passes beneath the tray bottom at the center to strengthen the assembly. The bottom is a simple rectangle with a 1"-deep scallop at each end to provide finger clearance. Assemble all

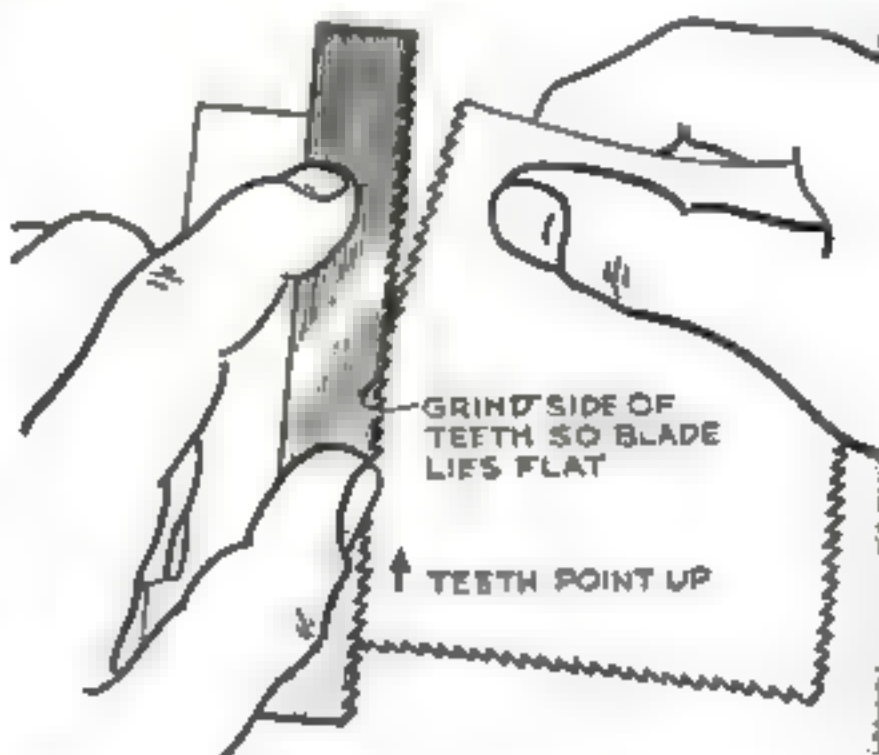


parts with glue and drive small brads into the dowels from the edges to keep them tight.—G. E. Hendrickson, Argyle, Wis.



Paint Balance Point on Ladder

CARRYING a long ladder from place to place can be clumsy if you must shift it around to find the grip that will give proper balance. Locate this point and mark it permanently by painting the entire section between the rungs a bright color.—Daniel Bousha, Jackson, Mich.



Hacksaw Blade Trims Labels

LIKE decorative edges on your home-made labels? Grind flat the teeth on a 4" piece of coarse-tooth (10 to 14 per inch) hacksaw blade. Press the blade against paper stock laid on a flat surface and rip off all four edges.—Stanley Weirzak, Newton Upper Falls, Mass.

CHOOSE YOUR JOB TRAINING—THEN LEARN BY DOING

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ARMY



tack upon its orbiter in space, or not.

More-violent weapons, or those that would leave telltale wreckage, might be avoided as too provocative for cold-war use. To cope with anything as warlike as an H-bomb satellite, however, a country would probably pull no punches.

A nuclear warhead will be likely to arm an anti-satellite for that mission. Its explosion will be blastless in space—but its heat and radiation will be all the more potent, for lack of air to absorb them. At 100 yards, an aluminum satellite shell of 0.15-inch thickness would be vaporized by a small one-kiloton A-bomb. The flood of neutrons from the same explosion would disable an enemy nuclear bomb at more than quarter-mile distance, calculates Prof. S. Fred Singer, University of Maryland physicist. Because these nuclear particles would release additional neutrons within the bomb, they should overheat it enough to damage its mechanism and make it inoperative.

Even a ray gun is not too fanciful to be considered. Recently the Air Force awarded a contract to the General Electric plant at Santa Barbara, Calif., to study the feasibility of "ion-beam projectors" as weapons.

For lack of blast, common high-explosive shells will be useless in space. Among conventional weapons, the few effective ones include machine-gun bullets and shrapnel or fragmentation shells.

Guided accurately enough, even an unarmed Saint could destroy a hostile satellite by borrowing one of the earliest naval tactics—and simply ramming it.

Start already made. Designers of Saint will build upon well-known principles, and a pioneering experiment.

The rendezvous maneuver Saint will use has been widely studied, because of its many applications in future civilian space missions: to assemble space stations in orbit, to dock spaceships at them, to go to the rescue of a rocket ship in distress. Suitable trajectories, starting either from earth or a "parking orbit" above it, have been worked out by space scientists in great detail. Already on the drawing boards are designs for civilian spacecraft, both unmanned and manned, to ply these courses.

From paper studies, experimenters

have progressed to actual hardware. A forerunner of Saint was a 31-foot, air-launched Martin missile, dubbed Bold Orion by its maker. In a 1959 trial of anti-satellite guidance, this two-stage rocket hurtled to within about four miles of our orbiting Explorer VI paddlewheel satellite.

Convinced by last fall that an anti-satellite was feasible and needed, the Air Force outlined its requirements to 27 leading U.S. makers of spacecraft, and invited proposals. In December it

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Next Month: Agile as a skyrocket, ready as a rifle bullet, the first U.S. solid-fuel ICBM will be on the firing line by mid-1962. Read: "Minuteman: Our Ace in the Hole"—in July PS.
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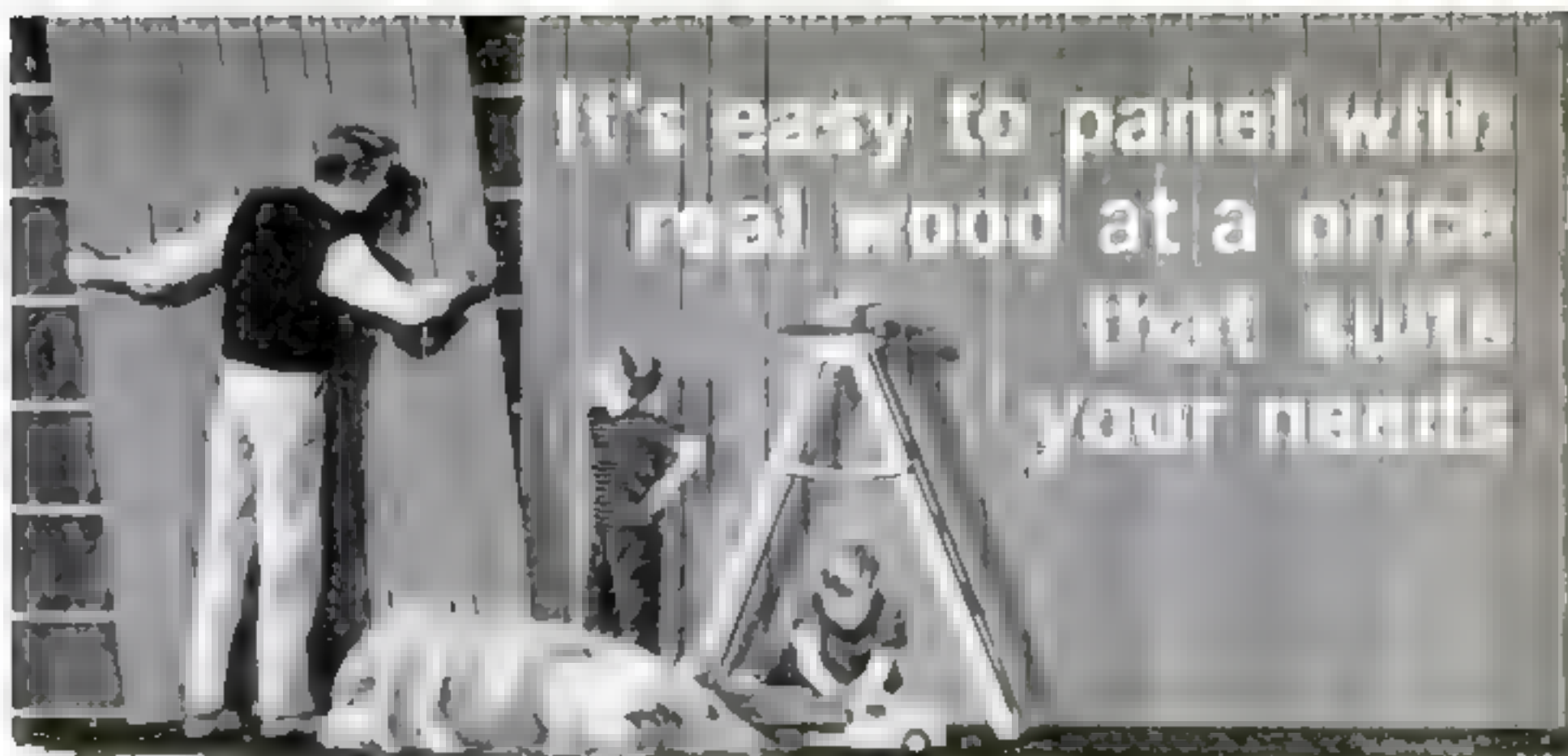
adopted a still-secret design submitted by RCA for the four trial Saints, which are reputed to be of about one-ton size. (Later ones may be twice as large.)

The future. Although early Saints will probably be limited to viewing a target satellite at a single pass, future models may permit repeated passes. An armed anti-satellite could first inspect an unidentified satellite—then, in response to a radio command, return for a kill.

Ultimately the future will bring manned military spacecraft—and space-war possibilities more fantastic than any in fiction. Encounters of killer anti-satellites on opposing missions, or of space destroyers with a manned military satellite, space station, or lunar base, may trigger anything from skirmishes to full-scale battles above the earth.

While space remains as lawless a frontier as our Wild West of other days, the U.S. has no choice but to prepare against space war. At the same time, it is actively seeking an international agreement—similar to one successfully negotiated for Antarctica—that would ban all military activities from space.

Thus, depending on the course of coming events, our Saint anti-satellites could be the prototypes for battle fleets in the wild black yonder—or for international space-police cruisers, enforcing the law and guarding the peace in regions beyond the earth. ■ ■



Georgia-Pacific makes it easy to panel any wall with the warm, lasting beauty of real wood • Fully illustrated G-P booklet gives simple, clear instructions: how to figure a room/how to make perfect joints/easy ways to panel around doors and windows/how to finish at ceilings and floors/how to make perfect inside and outside corners/many other

important points • A full line of Hardwood and Textured Plywood Paneling at prices to fit every job, from \$22.56 to \$74.88 for an 8' x 12' wall • Complete accessories: moldings to match every Georgia-Pacific hardwood/unfinished flush doors/color-matching putty sticks, G-P filler-stain-sealer combinations, and exclusive G-P plastic topcoat finish.

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Family-Proof Paneling Premium hardwood. Family-Proof finish* 4' x 7', 8', 9', 10' panels. American Black Walnut; American Cherry; Brown Elm; Blond Oak; Honeytone Oak; Flame Gum; Pecan; Adirondack Birch; Greymist Ash. .48 - .78¢ per sq. ft.; \$46.08 - \$74.88 for 8' x 12' wall.

Cottage Paneling Hardwood with natural growth characteristics. Family-Proof finish* 4' x 7', 8', 9', 10' panels. Walnut; Oak; American Elm; Antique Elm; Birch in Natural, Cherrytone, Greytone, Mapletone, Antique. .49 - .66¢ per sq. ft.; \$47.04 - \$63.36 for 8' x 12' wall.

Grain Ply Paneling Hardwood with realistic wood grain. Catalyzed Resin finish. 4' x 7', 8', 9',

10' panels. Oak in Tan, Acorn, Smoke; Teak in Cashmere, Sumatra, Rangoon, Ceylon. .43½ - .48¢ per sq. ft.; \$41.33 - \$46.08 for 8' x 12' wall.

Textured Paneling Douglas Fir in 4' x 8' panels; 12", 16" sqs. Striated: Deep, narrow grooves. Natural or Factory-Coated. .23½ - .30¢ per sq. ft., \$22.56 - \$28.80 per 8' x 12' wall. Deep Etched Ripplewood®: Grain contours in relief. .26 - .29¢ per sq. ft., \$24.96 - \$27.84 for 8' x 12' wall.

*G-P Family-Proof finish is the most protective ever developed. Hand-rubbed look defies scuffs, scratches, crayons, paint—even boiling water. Smudges wipe clean.

All hardwood paneling has random-spaced V-grooves, with edges sased to form V-joint butt. Guaranteed against structural defects for the life of the installation.

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Anti-Roll Tanks Banish Seasickness

(Continued from page 82)

its halfway mark with 85 tons of fresh water. This was only a third of one percent of the ship's total weight. The water was also the stabilizer's only moving part.

Tempest in a teapot. Now let's see what happened when the Matsonia nosed into rough seas.

As the first cross wave lifted her high, she behaved like any other ship—rolling away from the crest. (We'll say that the roll was to port). Naturally the stabilizer tilted, too, and the boxed-in water began to shift to the low side.

But the surge had to fight its way into and through the nozzles. This slowed it down so much that by the time the miniature tempest flattened out at an angle that put most of its weight to portside, the whole picture had changed. The crest of the ocean wave had already passed under the Matsonia, and she was beginning to slide down the far side. This started her on what should have been an equally heavy counter-roll.

It wasn't—because the delayed transfer of weight had the effect of a plump boy sitting on the far side of a seesaw. The Mat labored only a bit past vertical. In the last moments, the stabilizer tilted to starboard. The water reversed its flow and charged the flumes again. This time the lag put its weight to starboard just in time to counteract the pendulumlike action of a second ocean wave.

From there on in, the Flume Stabilization System had it made. Come big seas or little, just the right amount of water was in the right place at the right time to exert a powerful dampening force.

The ones that didn't work. Water cures for rolling have been tried before. Back in 1883, a stabilization tank was put aboard the British battleship Inflexible to hold gun decks steady while firing broadsides into the enemy.

The Inflexible's cross tank had a number of dams and baffles to slow surges of water through it. At times they reduced rolling as much as 50 percent. At others, the miniature waves got in phase with the big ones, and the not-so-Inflexible lobbed her shells toward outer space.

Another try was made in the early 1900s with the Frahn System. This one got into the holds of about 40 ships be-

fore everybody knew what was wrong with it. Four water columns, or "wing tanks," one fore and one aft, were on either side of the hull. Each athwartship pair was connected by a U-shaped tube at the bottom and an air pipe at the top. A throttle valve was cut into each closed circuit at the center of the pipe.

With the U tubes and half of each wing tank filled with water, the idea was to control weight transfers by metering the head of air building up in one tank to the other—and vice-versa—with just the right valve setting.

The Frahn System worked fine in heavy swells. But when the waves were very short, its reflexes actually amplified the roll. And the air that kept venting from one tank to the other hissed and hurped so soulfully that you could hear it from the crow's nest.

Custom-tailoring. As already demonstrated by the Matsonia, a number of U. S. missile-tracking vessels, and an oceanographic research ship, the Flume Stabilization System does its balancing act regardless of the type of waves. That's because each unit is tailored to its ship.

Engineers work out the contours of the tanks and flumes after study of the ship's trim, stability, and normal rolling behavior. (A battleship, for example, is designed for a short period of roll; a passenger vessel, for a longer and more comfortable one.) Placement is important. On the Lamont Geological Observatory's floating laboratory Vema, a location above the bridge not only stole no space below deck, but put the water in the best possible spot to cancel out the rolling of a heavily ballasted hull.

Electronic computers weigh the inter-related data and stutter out the answers needed for a set of working drawings. Then scale models are tested in tanks at Stevens Institute of Technology.

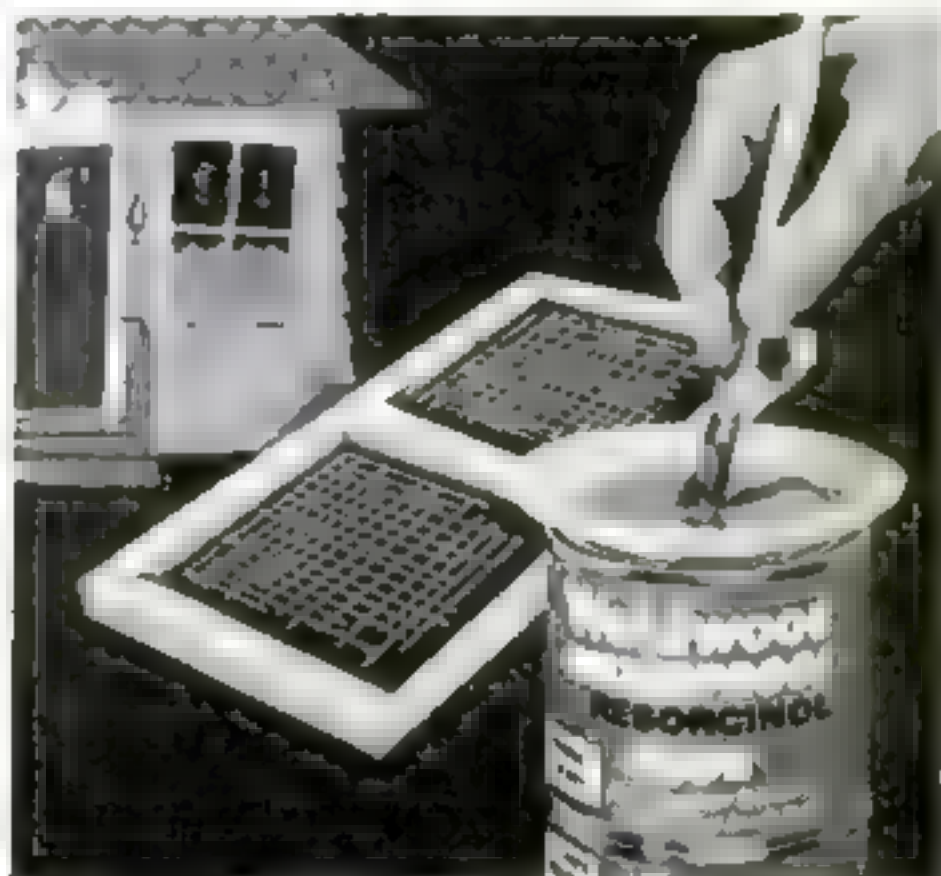
The cost? In the case of the Matsonia, \$200,000, or about one-fifth as much as that of a gyro- or fin-type stabilizer. The advantages? No mechanical parts to maintain or replace. There's none of the drag you get with fins, and the outfit works, unlike fins, when a ship is at anchor. Aboard a tanker, you could even fill the Flume Stabilization System with oil to gain cargo space. ■ ■

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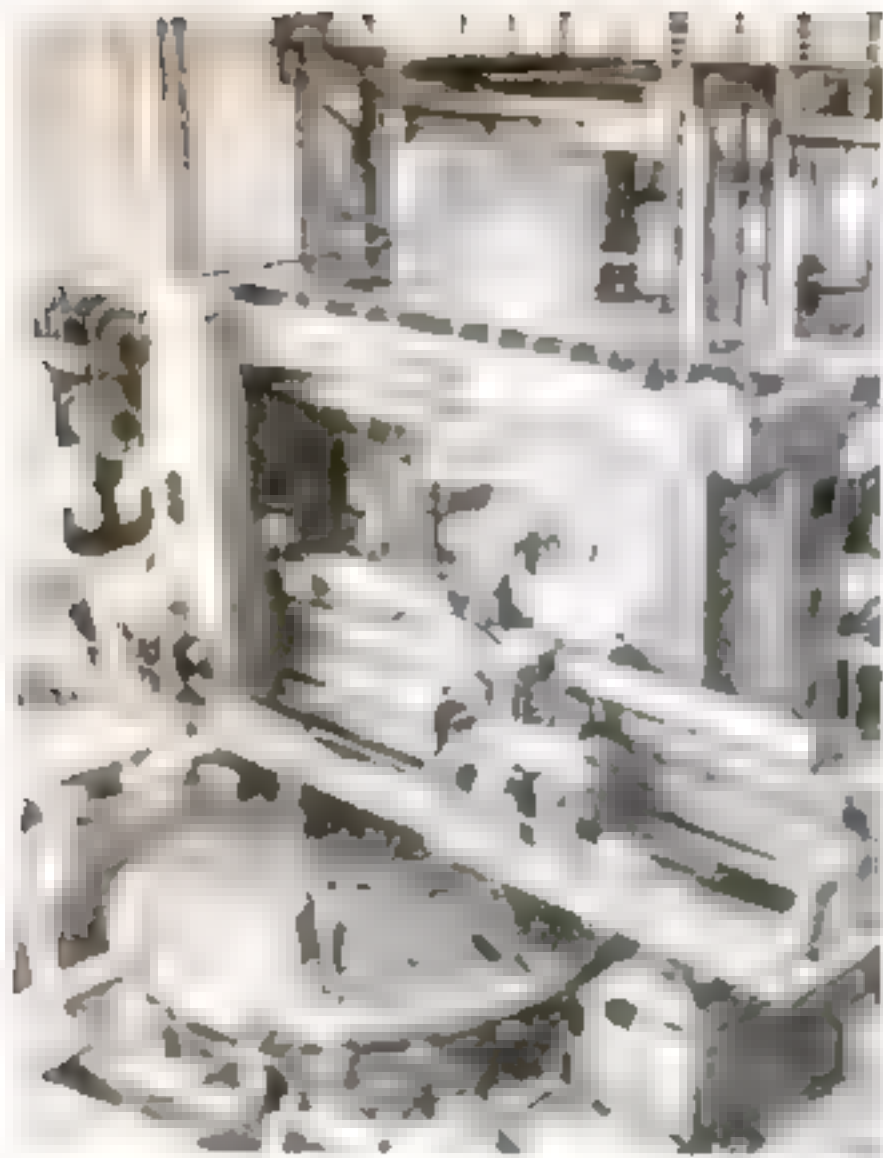


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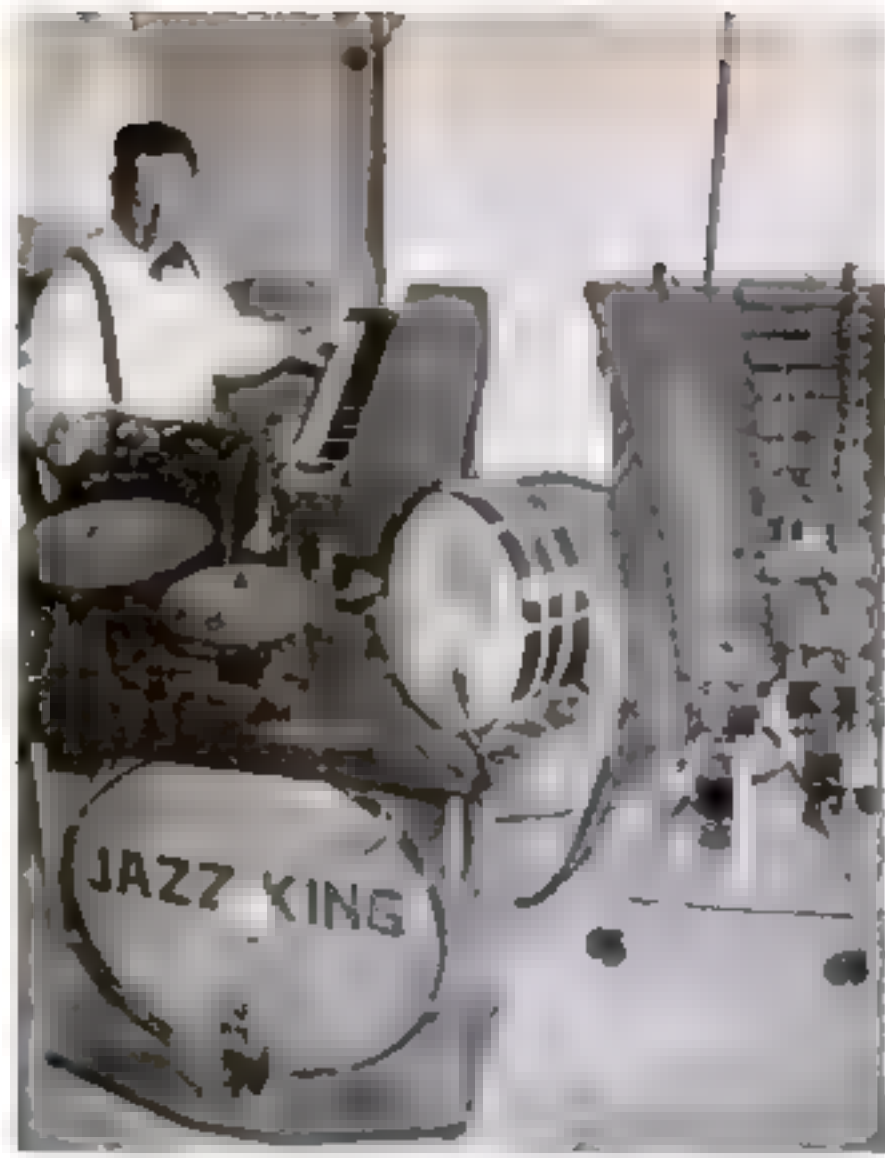
How handy to have supplies at your fingertips when you need them! It's easy. Keep these Weldwood® adhesives and finishes on your workshop shelf, and you're set for practically every job, indoors or out: Firzite, Exterior Stain, Spar Varnish, Resorcinol Glue, Wood Preservative. Total cost: only a few dollars. And you save yourself time and trouble! Shop your lumber yard or paint and hardware stores this week.



Products of United States Plywood



BIG RED MACHINERY. A huge vertical milling machine is installed above in a plant in Harbin, Manchuria. The Communists say they will use it in making giant turbine generators, some with a capacity up to 300,000 kilowatts.



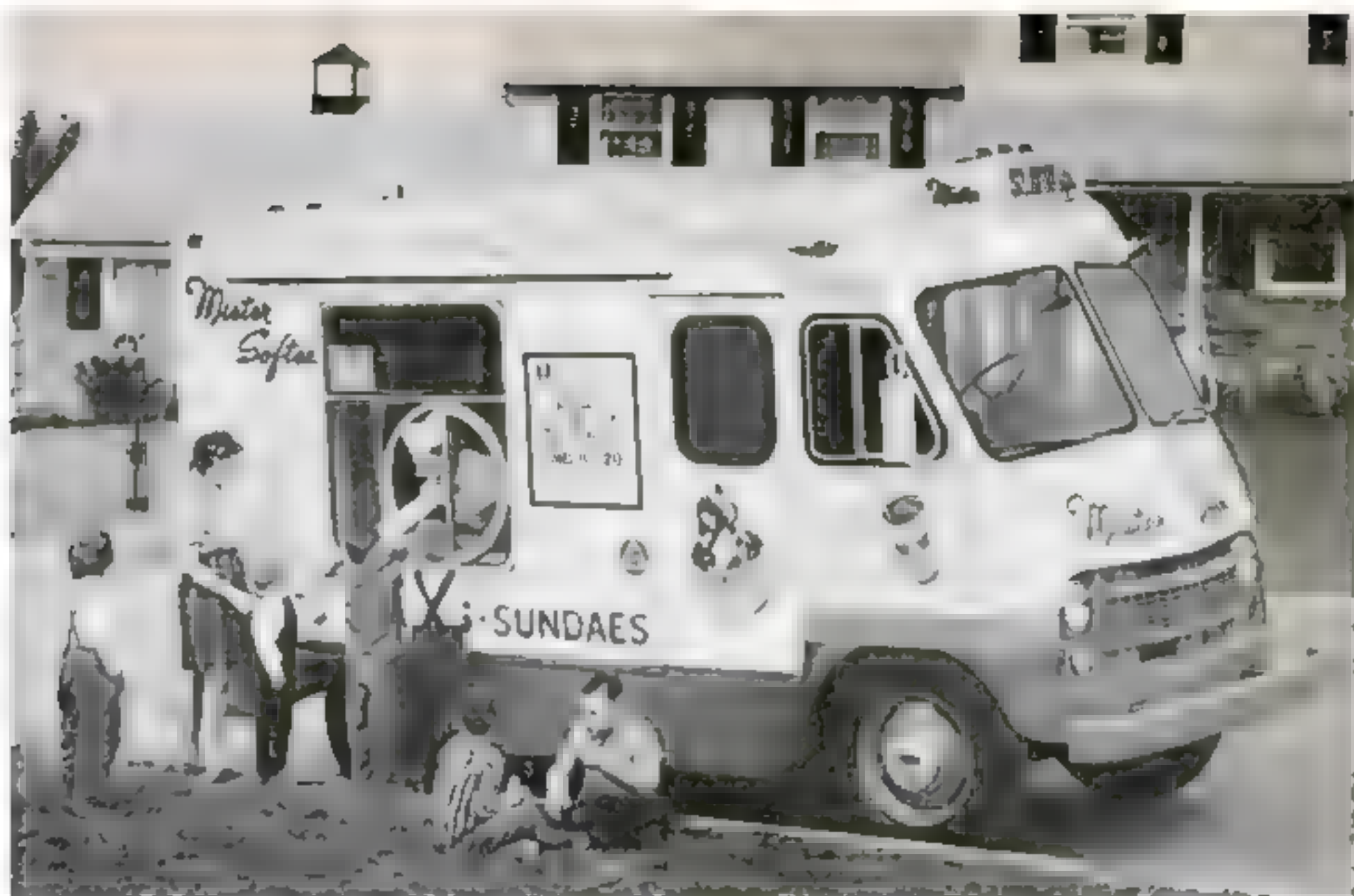
ONE-MAN BAND. Electric controls allow Alex Lifshitz, Brooklyn musician-inventor, to get notes from drums and a marimba at the same time. Buttons regulate the beat of the drums; he plays the marimba from the pianolike keyboard.



GIANT SEA CRANE. This big frame, straddling dock facilities like a huge sawhorse at St. Malo, where it was recently installed, is a major addition to the French port. The new traveling hoist has a lifting capacity of 235 tons.



TIRE RETREADER. This machine will be put into operation at Firestone's plant in Portland, Ore., to retread giant truck tires. It can handle 1,100 pounds of rubber, vulcanizing it on a carcass in 16 hours under 150 tons of pressure.



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"My earnings show that it would cost as much as \$161 a day to have my truck break down. The Ford's never failed me."



Douglas C. Adams
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"From one unit in 1958, I've built up to four and a business nearing \$100,000. Of course I recommend Softee—and Ford!"

the inboard-outboard manufacturers' claims for four-cycle economy are somewhat optimistic. Nowhere in the figures is there anything approaching the two-to-one fuel-consumption advantage claimed by some. In fact, the outboards got more miles per gallon at equal speeds in some instances and close to the same in others.

That the Volvo makes a somewhat better showing in fuel consumption than the two Interceptors is to be expected from the differences in displacement: The Volvo displaces 97 cu. in.; Interceptor 85, 144 cu. in.; and Interceptor 100, 170 cu. in.

Comparative fuel costs. These turned out a surprise. My averages were:

● Volvo inboard-outboard—5.06¢ per mile.

● Interceptor inboard-outboard—8.52¢ per mile

● Outboards—8.22¢ per mile.

Fuel costs will vary from one place to another, of course. My figures are based on gas at 30¢ a gallon for the outboard with 12¢ per gallon of fuel mix added. Including the recommended oil changes (every 100 hours for Volvo, every 50 hours for Interceptor), fuel costs for the Volvo came to 31¢ and for the Interceptor to 32¢ per gallon.

The outboards appeared to give greater acceleration and reached planing speed more quickly than the inboard-outboards in identical hulls. Checking the weights, I found the inboard-outboard installations were from 263 to 485 pounds heavier than outboards in the same hull. Most of the weight difference favoring the outboard arises from the more favorable horsepower-per-pound ratio inherent in the two-cycle vs. four-cycle design. Lower weight is probably the big factor in the outboards' greater acceleration.

The tilt-up feature of the inboard-outboards is not quite as satisfactory as that on outboards. On outboards, the power plant above the pivot point helps counterbalance the drive head, making it easier to tilt either by hand or when striking a submerged object.

I found the center of balance of all the test boats with outboard installations to be farther forward than on comparable inboard-outboard jobs. For example: On

the Hydrodyne, the center of gravity with the Volvo was 4 feet, 1¾ inches forward of the transom, while the Merc was 4 feet, 8½ inches. On the Glass Magic, the Eaton measured 4 feet, 4¾ inches, and the Merc was 5 feet forward of the transom.

This suggests that the boat manufacturers may not be doing the inboard-outboards full justice by installing them in production hulls originally designed for outboards. They should perform better in hulls specifically designed for

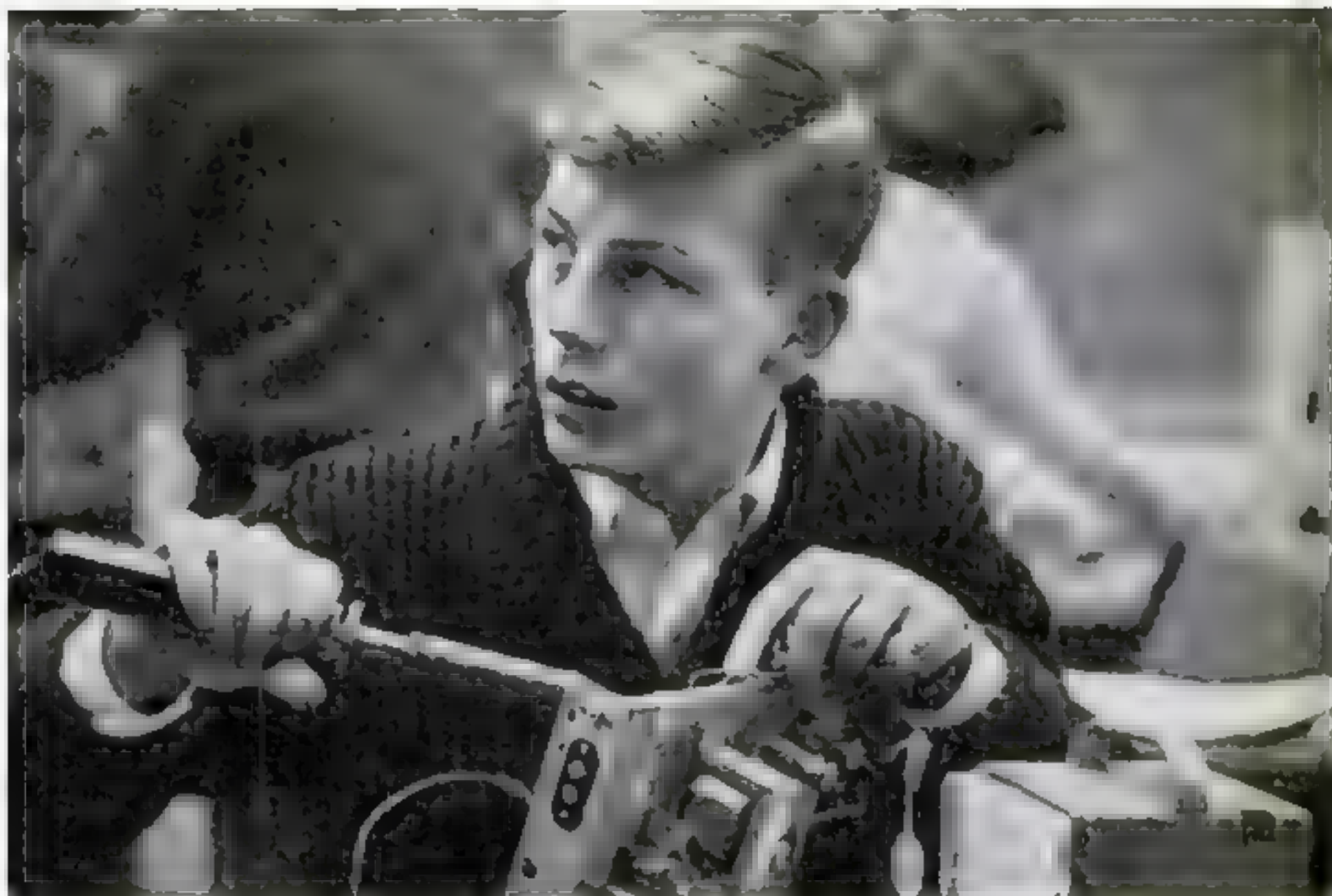
.....
Next Month: Now hydrofoil ships are going to sea, skimming the water at twice the speed of conventional liners. Read "Sailing Hydrofoils Fly Over Waves at 60 Knots" in July PS.
.....

the greater weight aft. I think a little added beam at the transom would let it reach plane quicker, plane cleaner, reach higher top speeds, and give better fuel economy at cruise.

The inboard-outboard is still in the development stage—particularly as applied to hull installations. It is apparently destined to fill a gap in power range where the outboard has reached a peak and the inboard begins.

Should you buy one? At present, the choice between outboard and inboard-outboard must be based more on personal taste than any clear-cut objective factors. The slight operating economy favoring inboard-outboards is offset by higher first cost. For example, the Glass Magic 17-foot Surfmaster with the Volvo installed costs \$1,995 above the price of the boat; with the Interceptor, \$2,195. An 80-hp. Mercury outboard would run about \$1,180 complete with accessories. So the inboard-outboard costs between \$800 to \$1,000 more for comparable boats.

The inboard-outboard should become more desirable, however, as more experience is gained by the boatbuilders—particularly when outdrive units are available that can be harnessed to larger inboard engines. The unquestioned advantages of steerable propeller, tilt-up protection, and thrust parallel to the planing surface could make conventional inboard power obsolete in larger boats. ■ ■



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U.S. Air Force



Airman 2C Shaw is now an electronics specialist at a base in England. He has completed a technical training course at Keesler Air Force Base, Mississippi. He is learning a valuable skill in his first year in the Air Force.



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Reynolds Metals Company
Richmond 18, Virginia

3/4 Hp. from a 3 1/4-Pound Engine

[Continued from page 67]

gees. After World War II, that plant turned out as many as 1,000 miniature engines a day.

Up in the air. Rice was usually in the air whenever he couldn't be found at a lathe. It was his good fortune to be able to combine a flair for publicity and an essential business errand with his pastime. Whenever a shipment of his model engines was ready for delivery to a distant city, Rice would fly the firm's well-emblazoned DC-3 to the spot—advertising his fast-growing business and having a ball at the same time.

About five years ago, the public's interest in flying model airplanes took a nose dive. Rice turned his avid attention to a bigger problem:

"Nobody had ever come up with a small, hand-held gas engine efficient enough to do the same work that a 1/3- or 1/2-hp. electric motor would do," he explained. "I decided to give it a whirl."

There were difficulties. The first was determining what size and speed of engine would be best for the wide range of work it was intended to do.

Rice decided to aim for the 1/2-hp. range, with lightness, portability, and dependability the acid tests of his experiments. (It is axiomatic among engineers that small gas engines don't quite match their electric-motor equivalent. A 3/4-hp. gas engine is about equal to a 1/2-hp. motor.)

Special magneto. Developing this was one of Rice's hardest tasks. What he needed was not on the market. What he created was a three-pole, low-voltage, high-amperage magneto, mounted on the end of the flywheel.

"It gives a great, fat spark," he said admiringly. "Why, it's capable of running your automobile! And it provides dependable ignition."

Another major problem was creating a diaphragm-type carburetor, essential for an engine that must be able to work in any attitude.

Finishing these two items and working the bugs out took 2 1/2 years of the engine's development time.

In ticking off some of the special attributes of the Ultra Compact, Rice mentioned that the engine had roller bearings not only on crankshaft and connecting

3/4 Hp. from a 3 1/4-Pound Engine

rod, but in the reduction gears as well. Also, he called attention to the integral automatic centrifugal clutch within the gearbox. About the size of a silver dollar, it engages automatically when the engine is opened up, drops out when it is slowed down.

"What excites me most about the Ultra Compact," he said, "is that, thanks to it, large areas of the world that have no electric power can now have power tools."

Response has been brisk in the U. S., but "fabulous" abroad, especially in Cen-

tral and South America and the Far East.

The design of the 1.26-cu.-in. two-cycle power plant is conventional. Compression ratio is a mild 4.86:1.

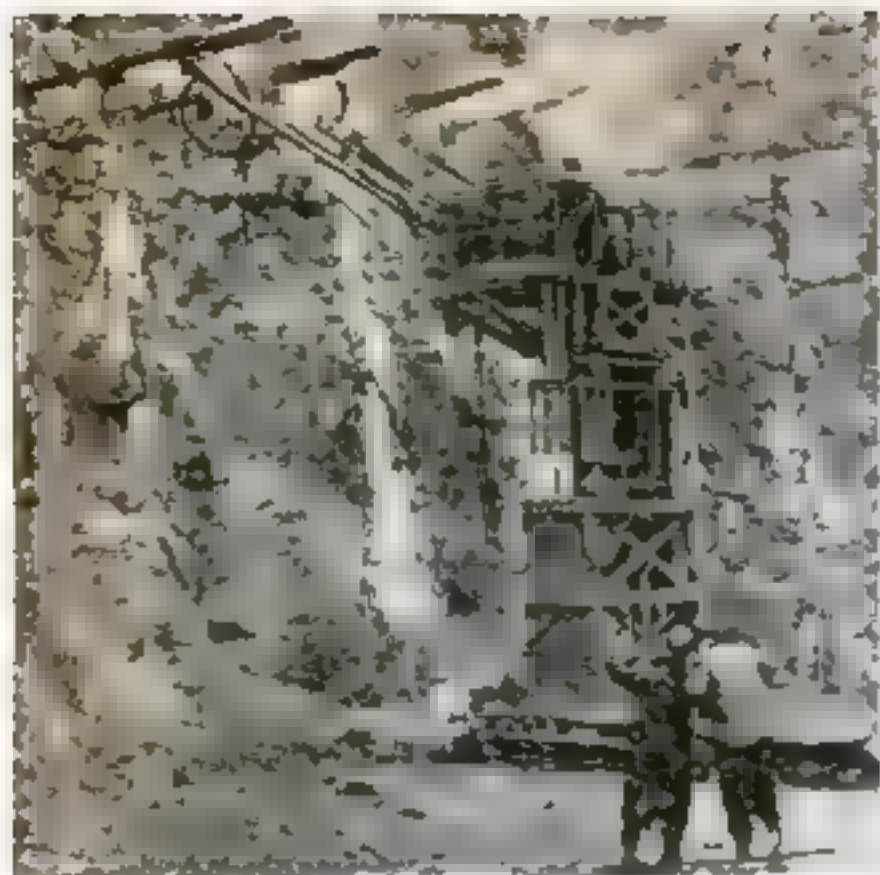
The basic engine is available in 11 different models whose r.p.m. output ranges from 6,300 down to 900, depending on gearbox reduction. Prices are from \$42 to about \$49. Optional equipment includes single-gear reduction, compound-gear reduction, centrifugal clutch, mufflers, base-mount or top-mount fuel tanks, and several air cleaners. ■ ■

PRINCE ALBERT 100's in U.S.A. 100's in U.S.A.

PRINCE ALBERT

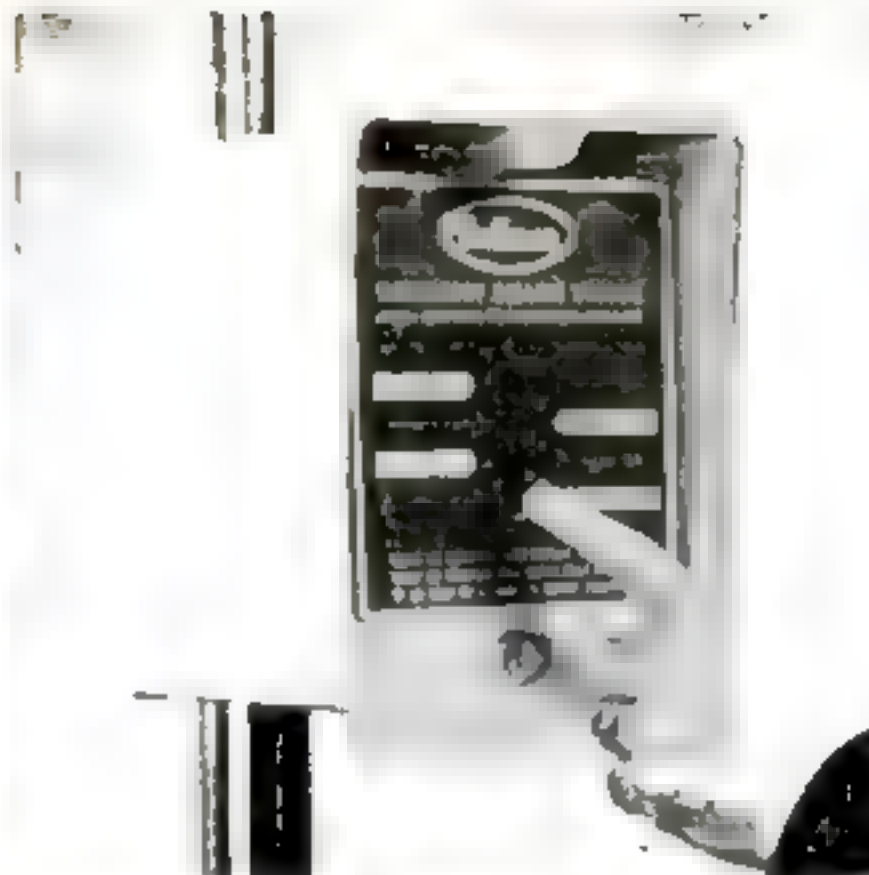
- always tastes fresh
- mild, mellow flavor
- cool 'n' steady burning

R. J. Reynolds
Tobacco Co.
Winston-Salem, N. C.



Tandem rock drills

High-speed quarrying is made possible by these tandem-mounted drills. Covering an area 24 feet wide and 32 feet high, the drills simultaneously cut four holes at any angle to a depth of 13 feet. Fifteen of the British-made rigs have been sold to Russia. In photo above, two Soviet engineers watch a demonstration at a quarry in Derbyshire, England.



Emergency roadside signal

With this emergency transmitter installed on the roadside, a stranded motorist wouldn't have to walk miles for help. Pressing a button summons police, ambulance, fire truck, or service truck. Nickel-cadmium batteries are recharged by five tiny silicon solar cells atop the pole. Range: up to 18 miles. It's made by Hoffman Electronics Corp., Los Angeles.

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fertilizers, and for other household, farm and suburban uses. The Sprayit 600 has all the quality-built, maintenance-free features found in every Sprayit product. Write for free catalog, showing full-line of compressors, guns, and accessories.



THOMAS INDUSTRIES INC.
Sprayit Division (PS661)
207 East Broadway, Louisville, Kentucky



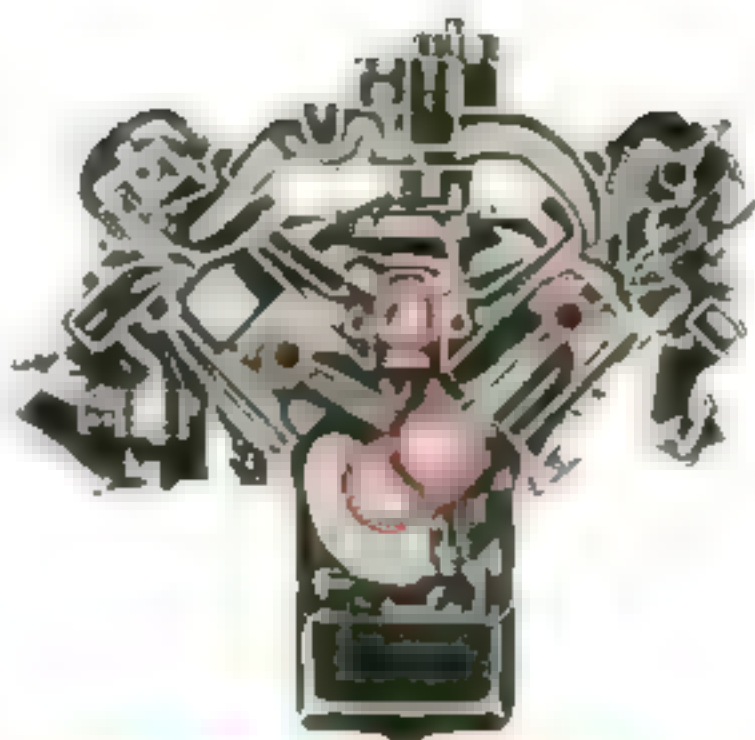
Sleeper-cab heater

A separate heating system for truck sleeping compartments has been introduced by the White Motor Co., Cleveland, on its 5400 Series models with fiber-glass cabs. Individual controls permit regulation of both heat and fresh air.



Sawed-off bazooka

Mobility and high firepower are offered by this light antitank weapon (LAW) demonstrated by a Marine above. The one-man rocket launcher, 3 1/2 feet long, resembles a sawed-off bazooka. The front-mounted sight gives good accuracy.



P*O*W*E*R

Built back in ailing engines

When a car engine gets tired, the symptoms are easy to spot. Performance is sluggish, gas mileage drops off . . . the engine begins to burn oil. The problem is wear. And the solution is having a skilled mechanic replace key parts.

Get a complete overhaul

New valves and rings are not enough. Why? Piston rings usually control oil from slipping into the combustion chamber, but even new rings can't control the more than 25 times normal amount of oil thrown off by worn bearings. This excess oil is forced into the combustion chamber where it burns to carbon and varnish. Deposits build up on valves, rings get clogged, and plugs become fouled.

Federal-Mogul for like-new power

Precision engine bearings are vital to getting maximum efficiency from your engine. That's why Federal-Mogul bearings are made to tolerances that give exact oil clearances . . . tolerances as close as .00025". And that's why Fm replacement bearings are best for your car—American or import.

If your car has a "tired" engine, give it like-new power with an overhaul that includes Federal-Mogul engine bearings.



FEDERAL-MOGUL SERVICE



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use it
as a
PLIER



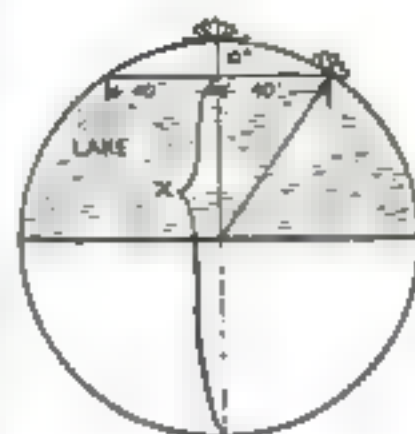
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as a
WRENCH

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Water lily. Think of the lily stem as the radius of a circle. The water's surface is a chord perpendicular to the radius. The product of the segments of a chord equals the product of the segments of the diameter perpendicular to it:

$$10x = 40 \times 40 = 1600;$$

$$x = 160.$$

The diameter is 170 inches. The lake depth is 75 inches.

Logic. Let each statement in turn be the true one and set up a "truth table." Make one quick observation: Statements 2 and 4 can never both be true or both false. Under the first set of conditions, Gus is guilty. (Statements 1, 2, and 3 are then false, the last one true.) Under the second set of conditions Dave is it. His statement is false, the others true.

Eggs. Spin the eggs. A hard-boiled egg spins long and steadily. A raw egg is wobbly. If you stop the egg in full spin and then release it, the cooked egg stays still; the raw one goes on spinning. What happens is that internal friction is set up as the raw egg's shell spins rapidly while the inner liquid lags behind. Part of the liquid's rotational energy then goes into heat so the raw egg slows down sooner. But if the shell is stopped, the liquid inside continues to move; hence the raw egg's impulse to continue spinning.

The oceanographer was referring to the earth itself. It behaves more like a raw egg, so its core is thought to be liquid.

Birthdays. At 25 people you're already past the break-even point! To figure it out, find the probability that out of a group of people *none* share a birthday. The first person can have his birthday any day. To be different, the second person is restricted to the remaining 364 out of 365 days, the third person to 363 out of 365, etc. The probability that no two share a birthday is simply the product of fractions: $\frac{364}{365}, \frac{363}{365}, \frac{362}{365}$, etc. At 23 people,

this product is already less than $\frac{1}{2}$. That means that the complementary probability—that *at least two people do share a birthday* is already greater than $\frac{1}{2}$.

Rifle. Tom saw the smoke first. (We all know how fast light travels.) Harry saw the bullet glance off the water second. Roughly, the muzzle velocity for a rifle bullet is between 2,500 and 3,000 feet per second. Dick was restricted by the speed of sound in air—a measly 1,087 feet per second.

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No. 4	4 1/2" Wt. 1 1/2 lbs.	Line pull of 50 lbs. on steel block	5.00
No. 5	3 1/2" Wt. 1 1/2 lbs.	Line pull of 30 lbs. on steel block	3.50
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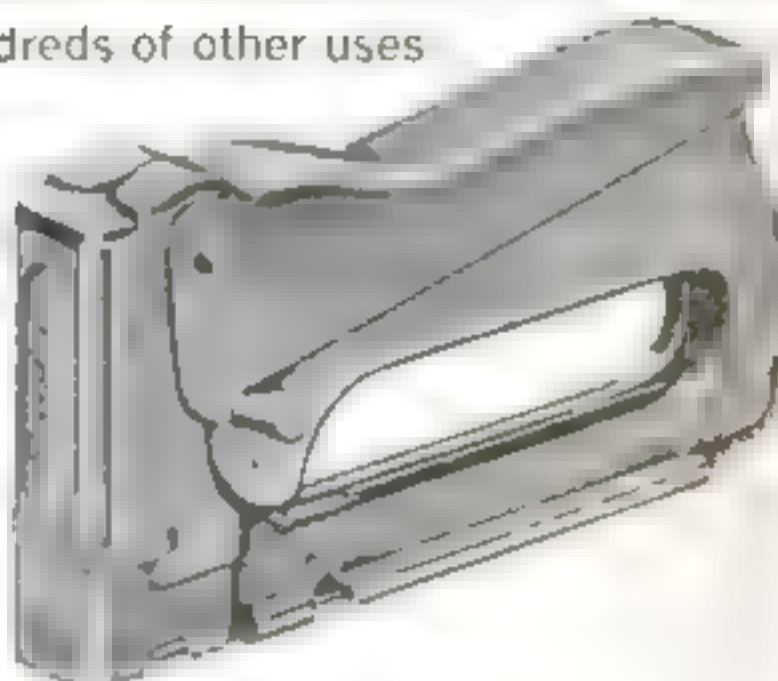


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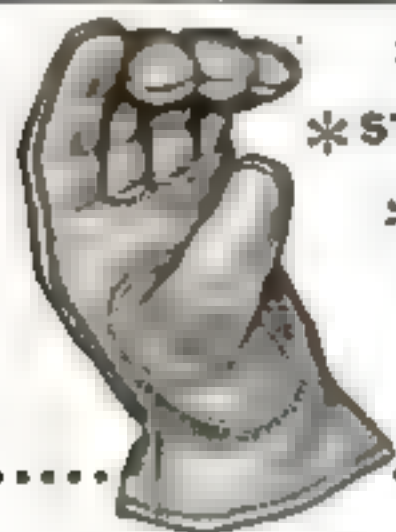


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- * WEAR LONGER
- * LEATHER

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WOLVERINE GLOVES

How Dangerous Are Guard Rails?

[Continued from page 49]

told, they aren't bad. Provided they were planted about four years before, and lived, and were maintained, and never hit, and are not asked to do too much in the way of stopping a fast, heavy car.

The whole record of guard-rail design is a history of ingenuity struggling against difficult physical laws. The earliest and worst rails were waist-high wooden fences. They were almost no obstacle to 4,000 pounds moving at speeds as low as 15 m.p.h. Worse, lengthwise pieces occasionally showed a gruesome ability to spear people. As long as 35 years ago, designers tried woven wire (better, though penetrable and very prone to pocketing). Next came three- and four-cable guard fences, much stronger though likely to snare a car abruptly. In recent decades many highway departments have turned to "ribbon" and "beam" rail. These are the long, curved steel strips, the former of a single-curved convex section, like a parenthesis, and the second like a W on its side.

Well, how good are they? The question pains highway engineers. They point out that thousands of miles of older guard rail run along U.S. roads, and that it would simply not be possible to replace them all. They warm to the argument that even an imperfect guard rail is better than none. (Although one cynical engineer expresses the belief that "the great bulk of existing guard rail is chiefly valuable as a road delineator.")

If you ask what type of rail works best, you also draw a pained expression—and a variety of answers. Common judgments are these:

1. Cable rail is strong, but it can be fierce. "It can turn an incident into an accident."

2. The simple ribbon rail is easier on cars and people at moderate impacts. But in short lengths it can pocket badly.

3. The W-shaped beam rail seems the most promising.

Crashes to order. Probably the most elaborate guard-rail test program ever staged was one General Motors ran off. The prime objective was to decide what kind of protection should be installed at the GM Proving Ground, where mileage amounts to 40,000 miles a day.

What started the program was the dis-

CONTINUED

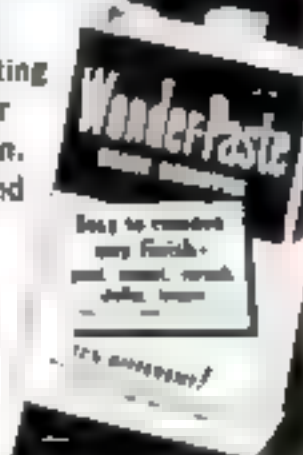
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How Dangerous Are Guard Rails?

covery that the existing rail there—
though built by the best standards of the
late 1930s, and well maintained—was
largely worthless. Traveling at only 35
m.p.h. and striking at a gentle angle, a
Cadillac had no trouble in thrashing
right through what had looked like
sturdy ribbon rail. So a full-scale test
program was laid on. It began with basic
lab and field testing: the tensile and
beam strength of various ribbons; what
it took to shear a mounting bolt; the
yield points of different designs of wood,
concrete, and steel posts.

In some crash tests, drivers, not using
belts or shoulder harness, drove cars at
slow speeds into guard rails, striking
first at gradual and then sharper angles.
Each driver was told to build up speed
at each specified angle until the shock
was as high as he cared to take.

The results showed a fine "repeat-
ability"—technical jargon for following a
uniform pattern. One finding was that
drivers almost invariably quit when the
gauges taped to their chests began to
near a peak of 3.5 Gs. This was a fairly
savage bang, occurring (for example) at
a 20-degree impact at speeds of about 19
m.p.h. Another curious finding was that,
with the W-type beam ribbon, bumper
engagement was unexpectedly neat. The
bumper tended to enter the center
groove and to track in that slot as the
vehicle crashed along.

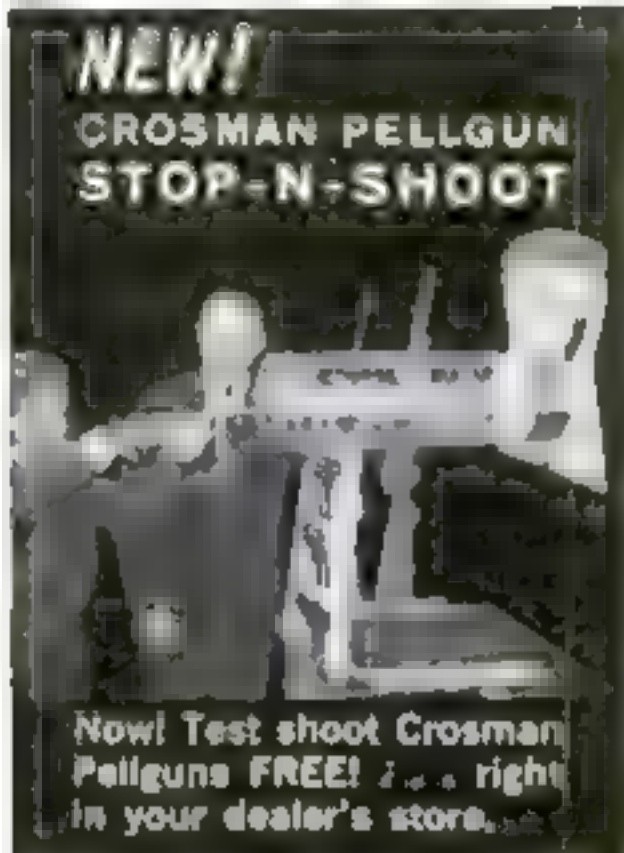
For moderate-speed crashes, remote-
controlled cars were used, rigged so that
they could be accelerated, steered, and
braked electrically through long cables.
For impacts up to 35 m.p.h. the engineer-
driver would guide the car from a sta-
tionary position, with the cables looping
between.

For high-speed impacts the setup was
trickier. The test car was controlled from
an instrument van or station wagon with
two drivers. One, in the driver's seat, had
the job of keeping the van or wagon in
position with the cables slack. (At high
speeds, the ideal position was about 200
feet behind and a trifle to the inside.)
The driver in the passenger seat, mean-
time, concentrated on getting his slave
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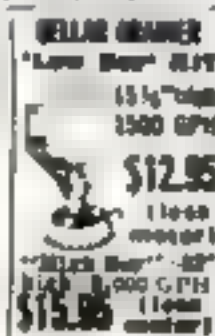


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How Dangerous Are Guard Rails?

radius doesn't make it much better.

Some of these conclusions, by the way, even though justified by the tests, may raise the hackles on highway engineers elsewhere. "It's all very well for a rich corporation," you can hear some state engineer boiling, "to call for over-design when it has only a dozen or two miles to fence in. How'd those guys feel if they had to guard hundreds or thousands of miles?"

The job of the posts. Absolute rigidity isn't desirable. It's better for the posts to yield successively under impact; this helps expend the car's kinetic energy, and a rigid structure would cause "intolerable lateral decelerations" (lingo for killing people). At the same time the posts should not bend or fracture at the ground line, for this can let the ribbon be dragged down and run over.

GM also concluded that there is a minimum length of rail that can withstand a particular impact and angle. The figures are much higher than in installations commonly seen on U.S. roads: At least 100 feet of guard rail are needed to withstand a 35-m.p.h. impact at 20 degrees; and a whopping 250 feet, with anchored ends, is needed to withstand a 65-m.p.h. crash at 20 degrees.

The tests settled one long-standing dispute. For years experts have argued over whether the ribbon should be rigidly or springily attached to its posts. No one denied that it was theoretically better to have a little springiness to cushion the shock; but might it not also encourage a car to carom off, perhaps to crash head-on against oncoming traffic?

GM's high-speed cameras have given the answer. At violent impacts, the forces and deflections are so large that there is no real difference between rigid and springy mountings. At medium and low speeds, the spring mounts do lessen the G loads appreciably. More remarkably, the snap-back of the rail doesn't take place until after the car has passed.

Do cars carom off guard rails? It's quite possible, especially after a light, flat-angled brush. And at high speed, where much kinetic energy has to be squandered in a second or two, anything can happen.

"Still, it's a serious mistake," one engineer says, "to think in terms of billiard

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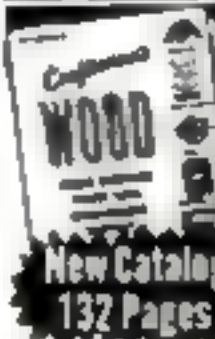


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balls. You are dealing with maybe 4,500 pounds moving at maybe 90 feet per second. This generates forces far beyond the limits of elastic rebound. If more people realized that you just can't deflect cars instantaneously, we wouldn't have so many useless little deflector rails."

Considering the forces involved, it's not surprising that weird things happen. The GM crews ran three tests on a new fence developed in California. Installed in the middle of divided highways to stop the dreaded cross-over accident, it works on a clever principle. Designed to "snare" cars, it consists of strong cables strung on a series of fairly bendable steel posts. Also part of the structure is a yard-high band of husky chain-link fencing. The cables provide the strength to keep the car from penetrating. So it slides along, bunching up the chain link ahead of it and slowing down at tolerable rates.

On the first try (see cover) a Pontiac whammed into the fence at 65 m.p.h. The fence worked beautifully. On the final test, at 35 m.p.h. and a very flat angle, the new fence also did fine, producing an impressively low one-G deceleration. But in the middle run, a Cadillac slammed in at 65 m.p.h. and all hell broke loose. In less than two seconds of violence the car slewed around and stopped, completely shattered. It had experienced, the instruments showed, a fearsome and unsurvivable 34-G shock.

What happened this time?

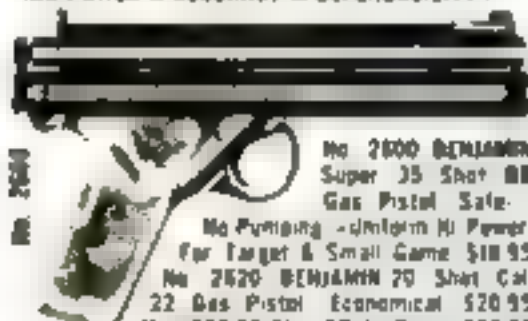
Analysis revealed that the big car had come into the fence exactly as planned. It had slid along the cables for almost 90 feet, flattening eight posts, bunching up the chain link ahead of it, slowing down at a nicely survivable rate. For a period of one second all went well.

Then at the ninth post, two forgotten turnbuckles in the cables snagged the even progression. Instantly the kinetic energy in the car was transmitted to the cables. The energy raced 150 feet back to where the cables were anchored to a heavy concrete "deadman" buried in the ground. The jolt was so severe that the concrete anchor flew up out of the ground, sailing almost 30 feet.

Then the dust settled over the wrecked, almost instantaneously arrested car, and the engineers were provided with another lifesaving piece of knowledge. ■ ■

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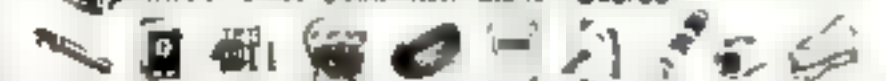


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Rebuilding Automatic Transmissions

(Continued from page 92)

had never fully entered the cylinder. The day after we fixed it, the owner was back, wild with joy and wanting to know what we had done." Hertel shrugged his shoulders. "The poor guy had been running on half a transmission simply because he didn't know what kind of performance to expect."

"These visits work both ways," Myles said. "Invariably, the Detroit boys learn something from us, and we learn from them. We allow them to ask all the questions they want for a day and a half, but the last half-day our boys pick *their* brains."

At this point, I decided to do a little brain-picking. As an amateur auto mechanic, I have had some unhappy experiences with rebuilt parts when repairing my own car.

New vs. rebuilt. I opened with a challenge. "My car has only 14,000 miles on it. If the transmission went sour, would I be better off having this practically new unit repaired, or exchanging it for a rebuild containing parts that may have seen many more miles of service?"

Hertel answered without hesitation. "If the trouble is more than adjustment, you're better off with the rebuild. One defective part in your new transmission can affect the entire core, especially if you drive with it a while. Past mileage is completely erased when we rebuild a unit. You get new bearings and clutches. Shafts are miked and discarded if worn. Many precision parts are replaced with new ones as a matter of routine. That unit is not only as good as new, it's seasoned." He pointed toward the service shop. "Why, we've found that if a customer can drive an automatic transmission for 60,000 miles without service other than adjustment, that unit has proven itself, and is likely to have another 40 or 50 thousand miles left in it. Particularly with the same kind of driving that it had before."

I've always enjoyed the pep and driving ease provided by my automatic transmission, but since I learned a bit about what goes on with those bands, clutches, servos, and planetaries, I've quit jumping out from zero to 60 in the rated 11 seconds. I want that 100,000 miles from my transmission. ■ ■

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WORK AND PLAY CHEVROLETS



The Corvair 95 design is a natural for camper body installation. Extra-low central floor section, just 16 inches off the ground, allows stand-up head room inside (plenty of room inside for cooking and other activities) with minimum over-all exterior height. Also, Rampside camper units offer walk-in side door convenience.



They're built to do a bigger, better day's work every workday in the week—and then head for the tall timber on those get-away-from-it-all fishing, hunting and camping trips you dream about! With roomy cabs and interiors, rugged build, and Independent Front Suspension ride, these dual-purpose Chevy models offer a really smooth way to rough it! *Camper bodies for Chevrolets are available from leading manufacturers everywhere.* They're tailor-made for Fleetside, Stepside or Corvair 95 pickups, and even for chassis-cab models if you want real house-trailer living. Many of the styles offered are readily removable, or otherwise adaptable to workaday truck operations, giving you versatility enough in one vehicle to last the whole year round!

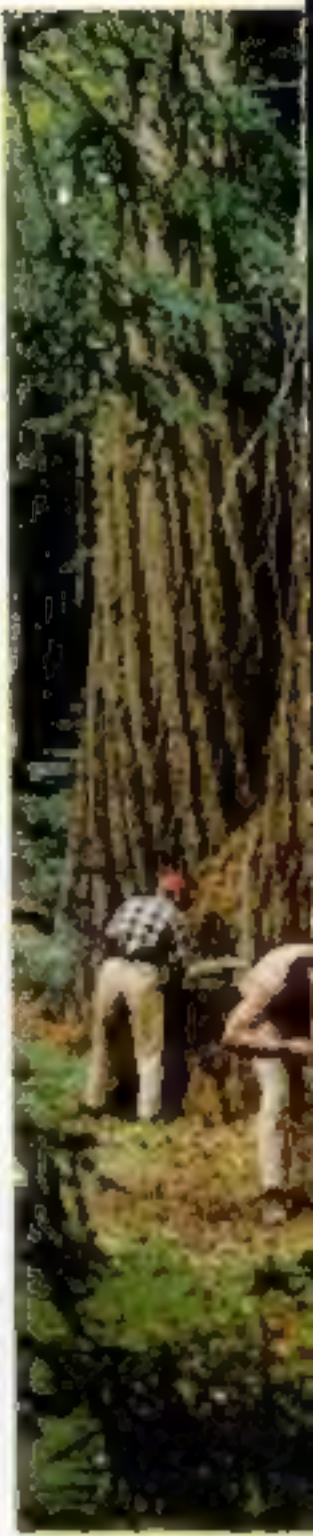


If your daily routine calls for a panel or crew carrier, take a good look at the Chevrolet Suburban Carryall. All-purpose transportation doesn't come any handier! With two roomy rear seats you can remove or rearrange in a jiffy, you can carry 3, 5, 6 or 8 people, plus tools, supplies or camping gear. With a Carryall, you're ready at the drop of a hat to get away from it all, wherever the gettin' looks best. Plan *your* next outing around one of these smooth-traveling work-and-play Chevies, and find out just how *versatile* a vehicle can be! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.





For big payloads or playloads you'll find the **Suburban Carryall** can't be topped. Rear seats are quickly removable, and interchangeable for any combination of passenger and cargo capacity. And there's plenty of room for installation of eat-and-sleep custom camper accommodations. Carryall is available with either station wagon tailgates or panel-type rear doors.



Chevrolet's conventional pickups are ideal for camper body with their close-to-the-road build and big pickup boxes. Many body designs take advantage of the low cab silhouette, with frontal overhang for extra body



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